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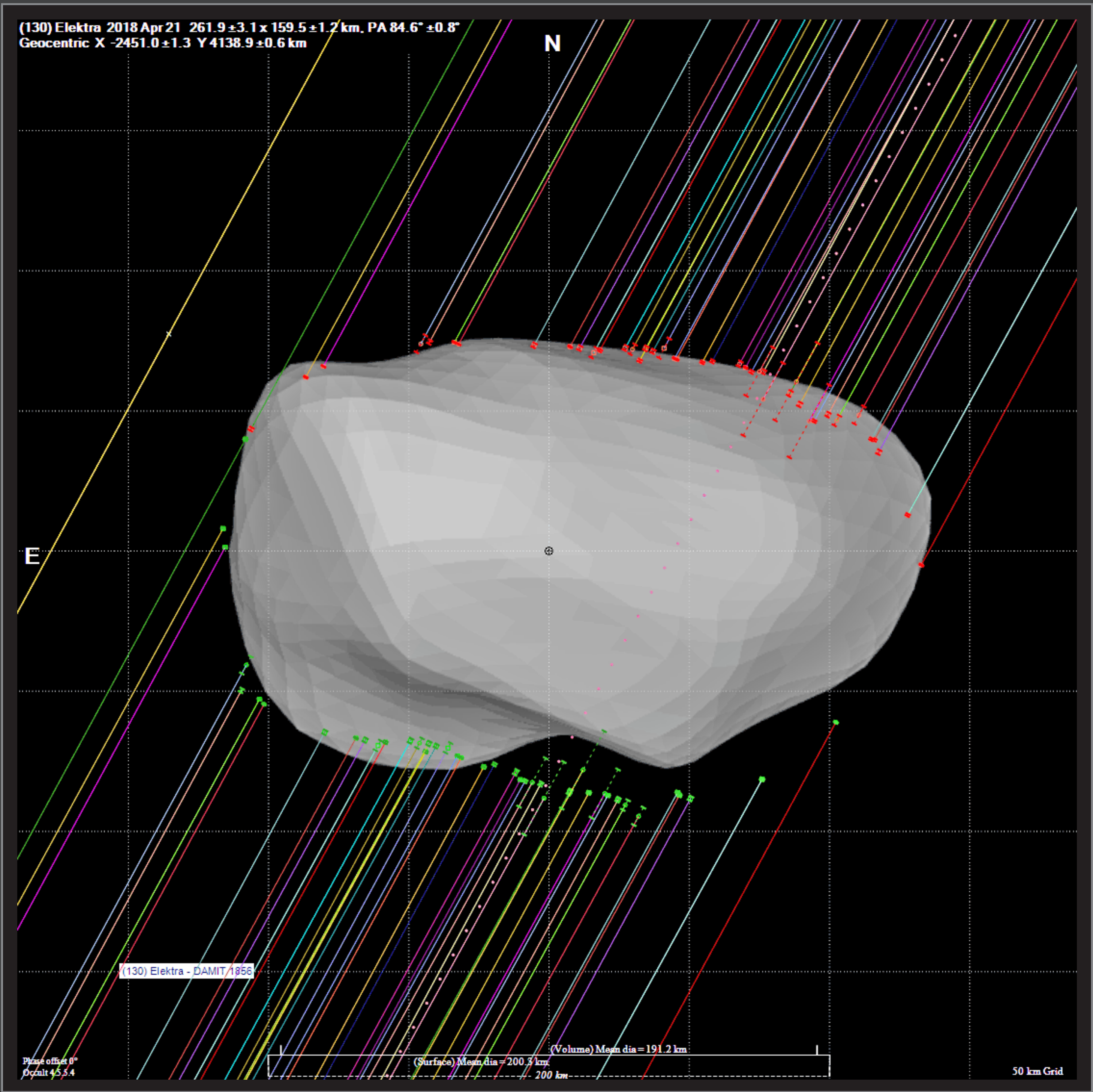


MAPPING (130) ELEKTRA'S PROFILE

Dear reader,

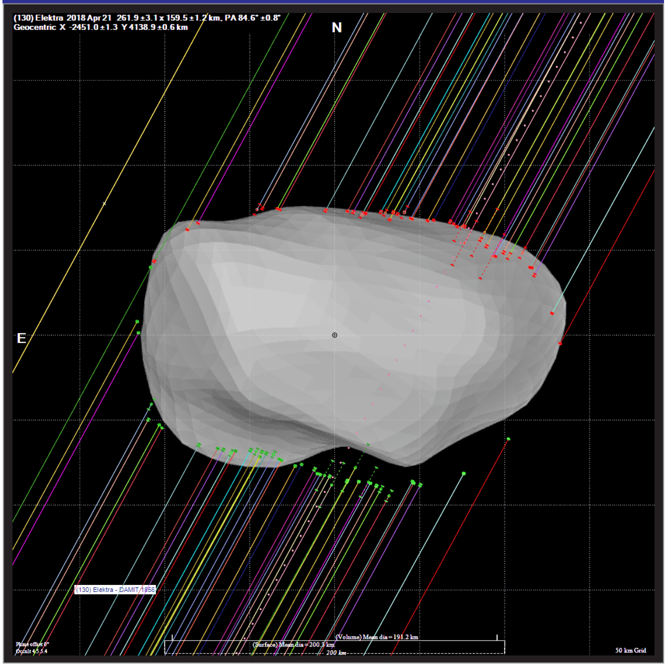
Helping observers to coordinate their observations to make the most of the opportunities has always been the main objective for organisations such as the Royal Astronomical Society of New Zealand (RASNZ) Occultation Section. This isn't easy across the length and breadth of New Zealand and Australia where observers are often many hundreds of kilometres apart and very limited opportunities for contact in person. It is much easier to keep in touch today with a range of online tools such as email lists and OccultWatcher and the section taking its first tentative steps into social media through Facebook.

But personal contact is always the best means of communicating complex ideas and coming up with new ones. One lasting legacy of Graham Blow, our section's founder, has been the idea for a regular meeting of Australian and New Zealand occultation observers modelled on the regular meetings in Europe and North America. He launched the first Trans-Tasman Symposium on Occultations (TTSO) in July 2007 – a meeting that included the launch of OccultWatcher. The tradition has continued with annual meetings alternating between Australia and New Zealand coinciding with every second RASNZ Conference in New Zealand and every NACAA (National Australian Convention of Amateur Astronomy) in Australia. 2019 sees TTSO13 occurring in New Plymouth in New Zealand on the 20th and 21st of May. You are all invited – either in person or via the Net – and you can find more details on our webpage.

Steve Kerr

Steve Kerr
Director – RASNZ Occultation Section

COVER



European observers measured 41 positive chords during the occultation of TYC 0408-00029-1, an 11.6 mag star in the constellation Ophiuchus, by (130) Elektra on 2018 April 21. The sky-plane plot by Eric Frappa (euraster.net) shows the measured chords fitted to DAMIT model 1856. This was the most successful asteroidal occultation observing cooperation in 2018.

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In this Issue:

Rules for Authors

In order to optimize the publishing process, certain rules for authors have been set up how to write an article for JOA. They can be found in "How to Write an Article for JOA" published in this JOA issue (2018-3) on page 13. They also can be found on our webpage at http://www.iota-es.de/howtowrite.html .

Paver Mounts Allow Mapping Elektra's Profile from North Carolina, 2018 May 1

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ABSTRACT: On 2018 April 21, 41 stations in western Europe and the UK recorded the occultation of 11.6-mag. TYC 0408-00029-1 by the large asteroid (130) Elektra, making it the best-observed asteroidal occultation of 2018. Ten nights later, another occultation by Elektra, of 10.7-mag. TYC 0411-00597-1, occurred in eastern North Carolina, providing a good opportunity to obtain another profile of Elektra at an orientation very different from that of April 21, allowing a good characterization of Elektra's three-dimensional size and shape. But the event occurred at an altitude of only 15° rising in the east with a 99% sunlit Moon 33° away. David and Joan were the only observers signed up on Occult Watcher (OW). Although they are experienced with multi-station deployments using methods developed by Scotty Degenhardt [1], there were only 2 ½ hours of useable dark time before the occultation. They overcame this challenge by deploying small telescopes on special "paver mounts" built by John Broughton the night before the occultation. Thus, the Dunhams were able to deploy seven stations across 2/3rds of the path of the occultation, allowing a second good fit to the latest DAMIT [2] shape model of Elektra. Besides being the most successful deployment of paver mounts for an occultation, it was also the first time that the new "Night Eagle" Runcam cameras were used on all (but one) station, and the first occultation that the Dunhams recorded with the "Wombat 200", John Broughton's latest suitcase telescope design. Other observers are encouraged to use these techniques for future challenging occultations.

The 2018 April 21 Occultation

Fortunately, clear skies prevailed over the April 21st Elektra occultation path in Italy, Switzerland, France, Belgium, and the UK, allowing that occultation to be recorded from 41 stations. Western Europe has the densest concentration of occultation observers in the world, permitting this great success, including in addition six other stations from which miss observations were made. In Switzerland, Stefano Sposetti provided three chords with well-separated telescopes. Eric Frappa's good fit of all of the observations to DAMIT model 1856 are shown in Fig. 1 [3].

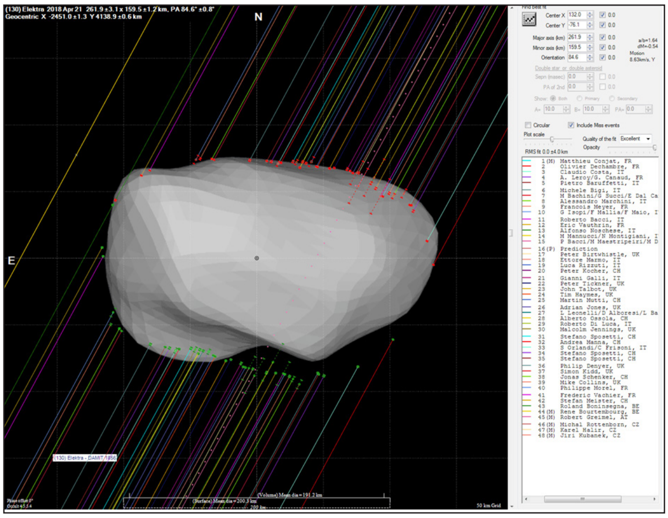

Fig. 1. Occult 4 sky plane plot, 2018 April 21 occultation of TYC 0408-00029-1 by (130) Elektra fitted to DAMIT model 1856 by Eric Frappa. See front cover of this JOA for a higher resolution view.

The Challenging 2018 May 1 Occultation

Ten nights after the April success in Europe, another occultation by Elektra, of 10.7-mag. TYC 0411-00597-1, occurred in North Carolina. Since both the April 21st and May 1st occultation stars had accurate Gaia DR2 data, an accurate prediction was made for the May 1st event using the April 21st result, as described in the last JOA [4]. Since the target was rising in the east, the altitude above the horizon was high enough (15°) only in the eastern half of the State; farther east, the path crossed the Atlantic Ocean and parts of western and southern Africa with no known occultation observers (Johannesburg, S. Africa, was the largest city in the path). Steve Preston's predicted path map generated with Occult 4 is shown in Fig. 2. The eastern USA, although quite populous, does not have as dense a network of occultation observers as western Europe, and the coverage is thinnest in the Carolinas. A call for observations was distributed by e-mail, but nearly all of the local observers apparently could not observe the occultation at the low altitude (atmospheric extinction would dim the star by at least a magnitude) in moonlight so none volunteered to try, to our knowledge, before the event. A multi-station deployment by the Dunhams, driving 500 km south from their home in Maryland, gave the best hope for covering the occultation. Fortunately, a high pressure ridge from Canada settled over North Carolina during both the UT nights of April 30 and May 1, giving good-enough conditions for observing at the rather low altitude above the horizon in bright moonlight. But with only 2.5 hours of dark time (after nautical twilight) before the occultation on May 1, there was time to deploy only three stations with the usual multi-station techniques; a more innovative approach would be needed to increase the number of stations to obtain a good outline for Elektra.

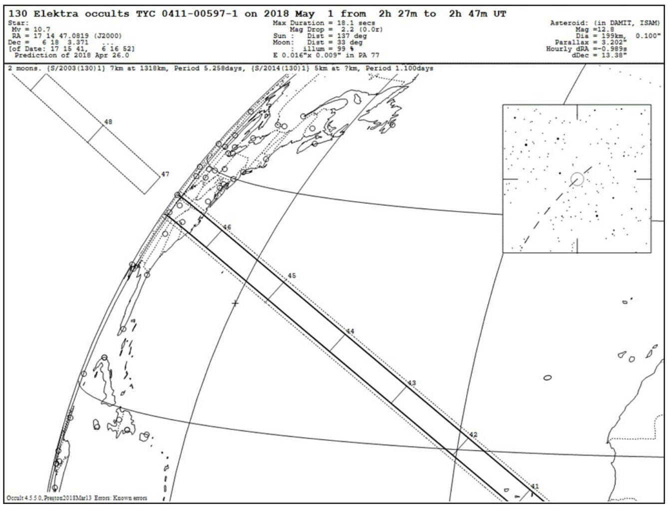

Fig. 2. Occult 4 path prediction for the 2018 May 1 occultation of TYC 0411-00597-1 by (130) Elektra.

Previous Night Deployment with Paver Mounts

A telescope can be pre-pointed to the altitude (alt.) that an occultation will occur at using a digital angle gauge, but magnetic compasses are too imprecise for a corresponding setting in azimuth (az.). To solve this problem, John Broughton developed a method to place a telephoto lens or small telescope in an adjustable frame that fits on a 30-cm-square (1 foot) paving stone. The paving stone can be set up the night before the occultation at a remote location where it is unlikely to be noticed or disturbed. The paver stone can be placed and the frame/telescope pre-pointed on it many nights before the occultation, but for travel to a distant area, as the Dunhams did for the May 1st event, it is most practical to pre-point the night before the occultation and stay in the area during the next day; this requires two consecutive nights of clear skies. The frame, which we call a "paver mount", can be placed on the paver stone and the telescope pointed at the occultation alt. and az. using pre-point star charts with the pre-point line of declination plotted (with the pre-point U.T. times marked at one-minute intervals). Once pointed at the correct alt. and az., the telescope is secured tightly to the paver mount, which is gently lifted off of the paver stone. The frame and telescope are then returned to the paver stone the late afternoon before the occultation, with a suitable recorder (usually a small computer or camcorder) attached to the sensitive camera on the telescope, and a mechanism (computer software or programmable remote) timed to record only during the few minutes around the occultation time. John Broughton has used the technique several times; in 2015, he provided David and Joan Dunham 4 early-design paver mounts while they were in Australia. They tried the technique on three events, with some success on each one, but with more failures due apparently to the frames not secured tightly enough, probably coming out of adjustment while driving over bumpy dirt roads. In one case, the station was attacked, probably by a dingo, disconnecting the camcorder from the telescope camera and ripping holes in a large bubble envelope that contained the recorder and programmable remote (which were not damaged); see Fig. 3. Fig. 4 shows placing the scope-frame back on the paver stone at another station that successfully recorded that occultation, the first previous-night pre-pointing with a paver mount for an asteroidal occultation by the Dunhams (they had an earlier success with a lunar grazing occultation).

Fig. 3. Station 4 for the 2015 July 31st occultation of a 10.3-mag. star by asteroid Bertholda, attacked probably by a dingo.

Fig. 4. David setting up another station, pre-pointed the previous night, for the same Bertholda occultation north of Alice Springs, Australia; this station was the only one that was positive (recorded the occultation).

In 2016, John Broughton designed lighter-weight paver mounts that we currently use with 80 mm "midi" and 120 mm "maxi" short-tube refractors. The one for 80 mm scopes is shown in Fig. 5. The design for the 120-mm scopes is similar, larger and with sturdier altitude bars for the heavier scope.

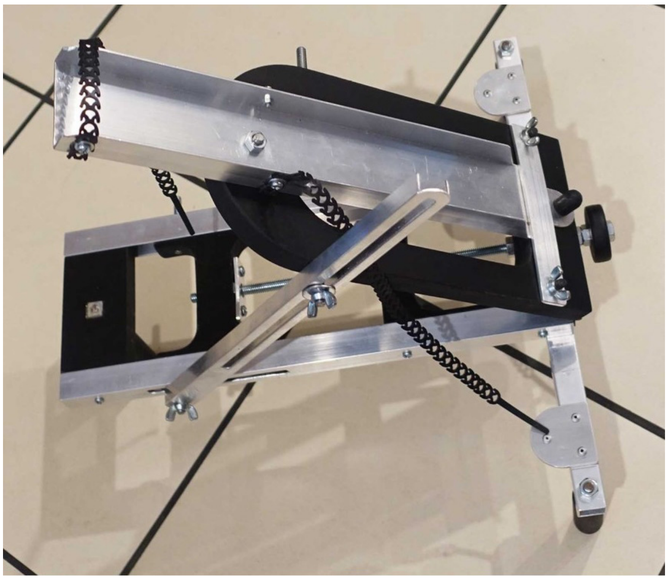

Fig. 5. John Broughton's paver mount design for an 80-mm short-tube refractor.

Because of their light weight, critical for air travel, we first used these mounts for the total solar eclipse in Indonesia in early March 2016. The mounts are very good, with smooth small and large adjustments possible in both alt. and az., so the Dunhams have used them on dozens of regular (same-night) multiple-station deployments; for them, three small cylindrical "feet" can be attached, as shown in Fig. 6. The mounts are effectively alt-az mounts only at low altitudes. They are really alt-alt mounts since they can point at the zenith, and there the two adjustments are both in altitude, at orthogonal azimuths. This makes them much easier to use than alt-az mounts at very high altitudes.

Fig. 6. Joan using an 80-mm refractor on a paver mount, testing for the March 2016 solar eclipse. Two of the three feet supporting the mount are visible.

Deployment for the May 1st Elektra Occultation

Occult Watcher was used to select seven sites, most near Interstate 95, the main eastern US highway that afforded quick travel between stations. For all stations, we planned to use the new Runcam Night Eagle cameras due to their sensitivity and half-inch chip, giving a larger field of view than the older sensitive cameras that we used for most past events. The four northern sites would be previous-night pre-points on paver stones; care was taken in their selection, to find remote locations, since the telescopes would be on the paver mounts for a few hours of daylight. We selected a motel near Wilson, NC, in the middle of the path, so we could scout out the four northern sites during the afternoon of April 29, as we drove south from Maryland. Then that evening, we drove back north, setting up the paver stone, and the scope with paver mount at each site, pre-pointing the scope, then tightening all the wing nuts on the paver mount and gently lifting it off of the paver stone and returning it to our SUV, at each of the 4 stations, and then returned to the motel. The next afternoon, we drove to the northernmost (#1) site, which was in Virginia, 4 miles north of the North Carolina border; from the prediction of the shape model and the April 21st observations, we expected that site to be about 15 km inside the actual northern limit. We returned the telescope and mount gently to the paver stone; that first site was about 200m from a brightly lit and busy travel center, but overlooking a large field towards the east, with the field separated from the travel center by a dense row of trees. We found that with the 120 mm scopes at the 15° alt., the paver mounts stuck beyond the 30 cm paver stone and was too heavy at the front, causing the scope to tip forward. To prevent that, we installed the front foot and pushed it into the relatively soft ground, which successfully prevented the tipping. Although this quick fix worked, John notes that he provided a second pair of holes so that the crossbar could be moved forward about 11 cm. Using them for the crossbar placed against the back edge of the paver stone, and removing a short metal bar at the front, would have made the mount stable at the low altitude. A picture of Station 1 is shown in Fig. 7. It shows blue 12 Volt batteries that were connected to the camera and the IOTA video time inserter (almost white box) shortly before we left the site. The observation was recorded with a small iView stick computer programmed to record for six minutes centered on the predicted event time. A piece of paper held down by 4 small stones above the telescope says "Please do not disturb, precisely pointed astronomical Station #1 to record the eclipse of the star .. by the asteroid 130 Elektra at 10:46 pm EDT this Monday evening, April 30, 2018. If you have questions or concerns, call David Dunham's cell phone, . ." and two Web addresses, one with Steve Preston's prediction, are given. As usual, we had no response to any of the papers we left with the equipment, showing that we had selected well-hidden sites. We did not take time to try to contact property owners, but rather found places either at the edges of fields or on clearly unused land that did not have "no trespassing" signs.

Fig. 7. Station 1, 120mm telescope with paver mount on paver stone at Skippers, Virginia, taken shortly after return to the station after the occultation.

The equipment at Station 2 is shown in Fig. 8. Unfortunately, a cable was not securely connected, resulting in a useless blank recording. The site was in the middle of an old road that had been mostly torn up with concrete barriers placed to prevent vehicles from entering, in bush about 100 m from currently used roads.

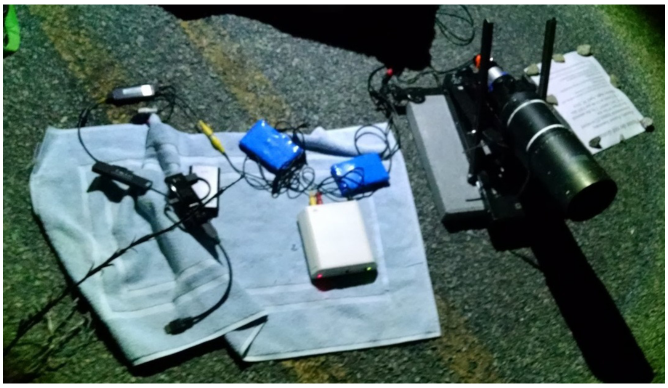

Fig. 8. Station 2,80 mm telescope with paver mount on paver stone at Roanoke Rapids, NC. This was the only station that failed, but this is the clearest view of the equipment at any of the stations..

The set-up at Station 3, as the Dunhams left it about 5 hours before the occultation, is shown in Fig. 9.

Fig. 9. Station 3, 120 mm telescope near Enfield, North Carolina.

The 80 mm telescope at Station 4 is shown in Fig. 10. This was the smallest telescope that recorded the occultation. With the atmospheric extinction resulting in the target star appearing only about mag. 12 in a moonlit sky, we were not sure this telescope could record the occultation, but it had a larger field of view, making it more tolerant of pointing errors, than the 120 mm telescopes. Consequently, we used alternating pairs of each for the deployment. Poison ivy covered the ground near the tree where the Station 4 equipment was placed. David got some on his hands and spread it when he showered the next morning; he itched for a month afterwards.

Fig. 10. Station 4, 80 mm telescope among a small grove of trees at Dortches, North Carolina. The Dunham's vehicle is visible in the upper right, parked at the side of a lightly-travelled road.

The Dunhams returned to their motel near Wilson, where they loaded their vehicle with three "suitcase" telescopes, built by John Broughton, for that evening's deployment to three stations farther south, the first being only 300m from the motel. They had time for a quick dinner before it became dark enough for the first pre-pointing of the evening of April 30, using the new "Wombat 200" (with 8-inch mirror) shown in Fig. 11. The Wombat 200 uses an alt-alt mount, like the paver mounts. The Dunhams could not achieve focus with a Runcam camera, so rather than take valuable time to figure out why, they used a Supercircuits PC164C-EX2 camera instead.

Fig. 11. The "Wombat 200"mm suitcase telescope used at Station 5 at Lamm, North Carolina, a small suburb of Wilson, is in the foreground in this picture taken at IOTA's display at the Northeast Astronomy Forum earlier in April 2018. A 120 mm "maxi" refractor on a paver mount is in the background.

The Dunhams next drove to Pikesville, NC, where they set up and pre-pointed Station 6. They did not take any pictures at their last sites, but at Stations 6 and 7, they used 10-inch suitcase telescopes (Broughton's original 2011 design with an alt-az mount) like that shown in Fig. 12. The Dunhams did not have time to drive to their intended site for Station 7, but were able to go 4 km south of Station 6 to their last station on the north side of Goldsboro, NC, for their successful attended station observation.

Fig. 12. A 10-inch suitcase telescope deployed in Australia, like those used at Stations 6 and 7 in North Carolina.

After the occultation, the Dunhams drove north, collecting the suitcase telescopes at the 3 southern stations and leaving them, still mostly assembled, in their motel room. Then they drove on, collecting the equipment and paver stones at stations 4 to 1, now with room in their vehicle to leave them mostly assembled. After arriving back at the motel, they were able to get a few hours of sleep. Late in the morning, they partially disassembled all of the equipment, for packing their SUV for the drive back home in Maryland.

Results of the May 1st Elektra Occultation

On reviewing the recordings, we were surprised that Station 1 had a miss (more on that below) and disappointed at the failure at Station 2, but were happy that, like Station 1, Stations 3 and 4 were pointed well enough on their paver stones to record the correct star field at the time of the occultation. The occultation can be seen clearly in the recordings at Stations 3, 5, 6, and 7. Station 4 presented special challenges due to the small size of the telescope. Tony George used Registax to combine many frames, shifting them to take into account the drift of the star through the field of view of the stationary telescope, as shown in Fig. 13. Going through eight steps (a separate short article could be written about it), Tony George was able to use Limovie, VirtualDub, PSF photometry, and ROTE to measure the star with S/N 0.69 and determine times of the occultation. Although the error bars were large (1.3s at 95% confidence), the event points agreed well with those from the adjacent stations and with the fitted shape model.

We learned after the event that Michael Fulbright, observing with an 8-inch telescope from near his home in Cary, NC close to the predicted central line, also recorded the occultation. The results of the whole effort are shown in the annotated map of the stations from Occult Watcher in Fig. 14. Although Dunham's Station 1 was north of the predicted

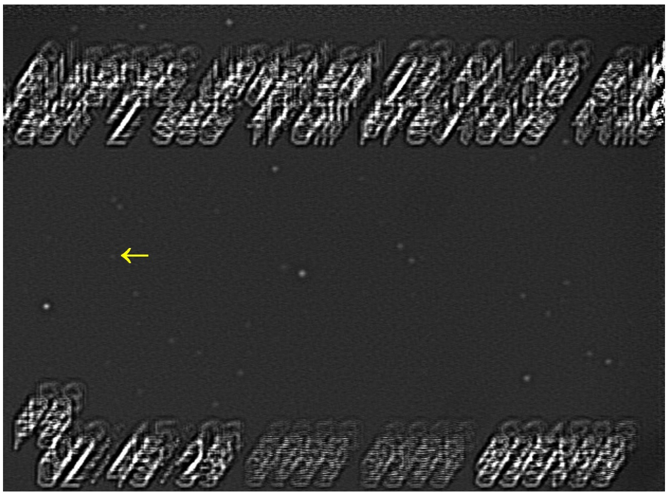

Fig. 13. Many frames from the Station 4 video are combined to reveal the target star.

northern limit shown, that was just based on a mean spherical size of Elektra. Using the small offset to Elektra's ephemeris determined from the April 21st observations and the shape model projected in the sky plane at the time of the May 1st occultation showed that the actual northern limit should pass a little north of Station 1.

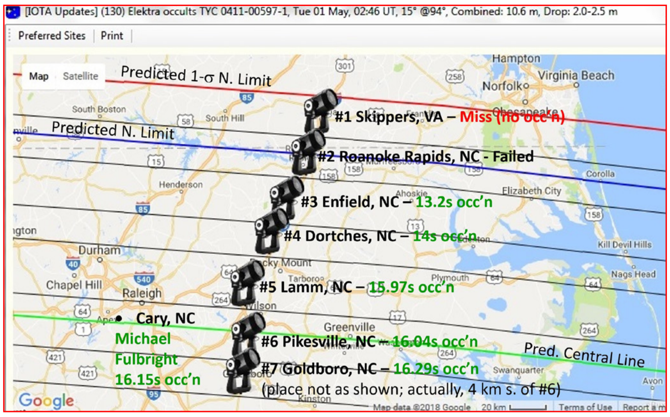

Fig. 14. Results of each of the Dunham's stations, and that of M. Fulbright, are shown on this map from Occult Watcher.

Tony George and the late Brad Timerson analyzed all of the Dunham videos, and combined all of the observations into an .obs file to analyze with D. Herald's Occult 4 program. The resulting sky-plane plot of the observations fitted to DAMIT model 1856, like Fig. 1 for the April event, is shown in Fig. 15.

The DAMIT shape model was scaled and shifted so that Station 1's line just misses the mountain on the upper left side of the shape model. But the scale that was found from the analysis of the better-observed April 21st occultation should be fixed at that value for the May 1st event and the observations fitted to that shape without regard to what happened at Station 1. It may then be that Station 1's line would pass through the mountain, ruling out its existence, similar to the way that some features of the shape model shown in Fig. 1 don't agree with the April 21st observations (although most are all right).

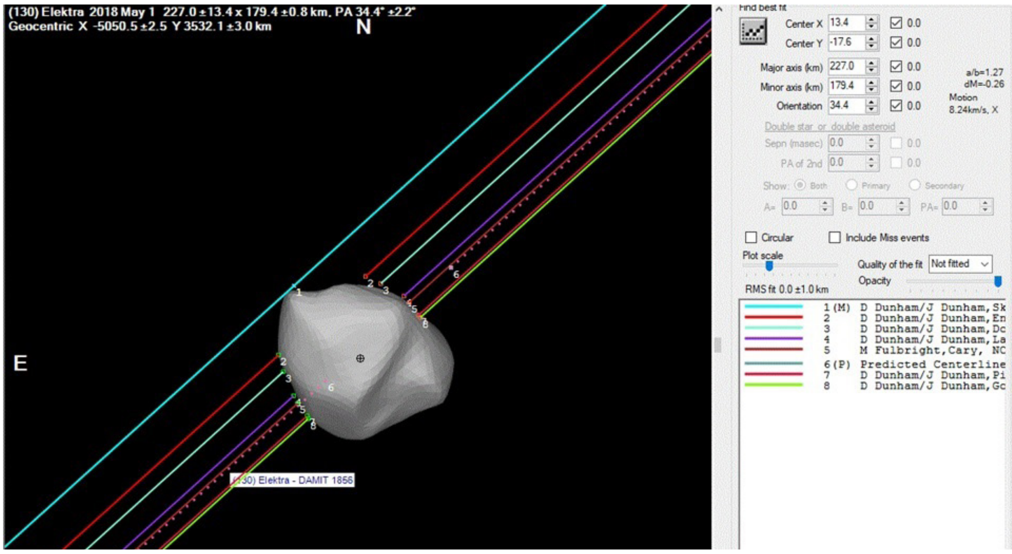

Fig. 15. Sky-plane plot of the observations of the May 1st occultation by Brad Timerson. To obtain Dunham Station #'s, add 1 to numbers 2-4 in the plot, and subtract 1 to numbers 7 and 8 in the plot.

Other Elektra Occultations

Besides the two 2018 occultations, another multi-chord occultation by Elektra was observed from the United Kingdom on 2010 February 20. The sky plane plot for the event is shown in Fig. 16 [5]. The DAMIT shape models for Elektra were not available in 2010. It's interesting that two of the 2010 observers, Peter Birtwhistle and Tim Haymes, also observed positives during the 2018 April 21st event.

In addition, other occultations by Elektra were observed as positive by 1 or 2 observers, on 2007 Aug. 27 (Turkey), 2007 Nov. 1 (Arizona, USA), 2009 Dec. 1 (British Columbia, Canada, double star), 2009 Dec. 3 and 2010 Jan. 8 (Arizona, USA), 2013 July 10 (New Zealand), 2013 Oct. 5 (Queensland, Australia, 2 stations by John Broughton), 2016 Feb. 16 (California, USA), 2016 March 9 (Virginia, USA), and 2017 Feb. 19 (Spain).

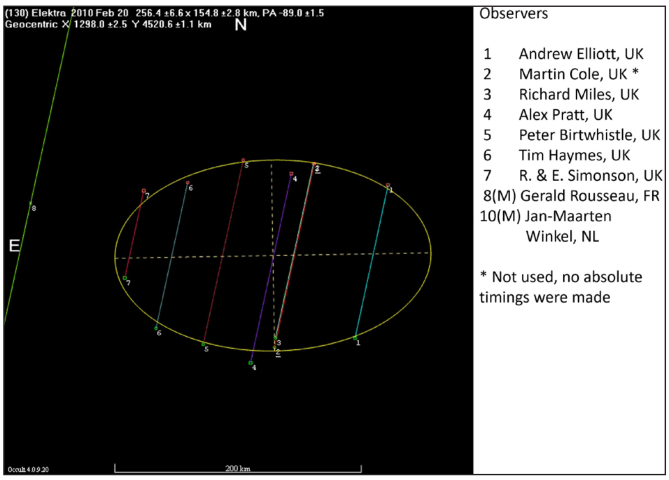

Fig. 16. Sky-plane plot of the observations of the 2010 Feb. 20th occultation, by Eric Frappa.

Conclusions

We have shown how novel techniques and special equipment (especially paver mounts) can be used to increase the number of stations deployed for asteroidal occultations, even when there is little dark time before an occultation on the night of its occurrence. The May 1st observation of the occultation by Elektra resulted in a third well-observed profile of the asteroid, allowing in principle a good determination of its rotation and three-dimensional size and shape, especially when used in conjunction with shape models determined from light-curve inversion. In addition, the three well-observed events shown could be used, along with the other occultations by Elektra and with Gaia DR2 data for the stars, to determine a highly accurate ephemeris for the asteroid, allowing even better predictions for future occultations and possibly determination of approximate masses of other asteroids that pass near Elektra. We thank the many observers who timed occultations by Elektra over the years that are described here.

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Grazing Occultations of Stars by the Moon in 2019

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The following maps and tables show this year's grazing occultations of the brightest stars by the Moon in those regions of the world where most of our observers live. The overall limiting magnitude is 5.0.

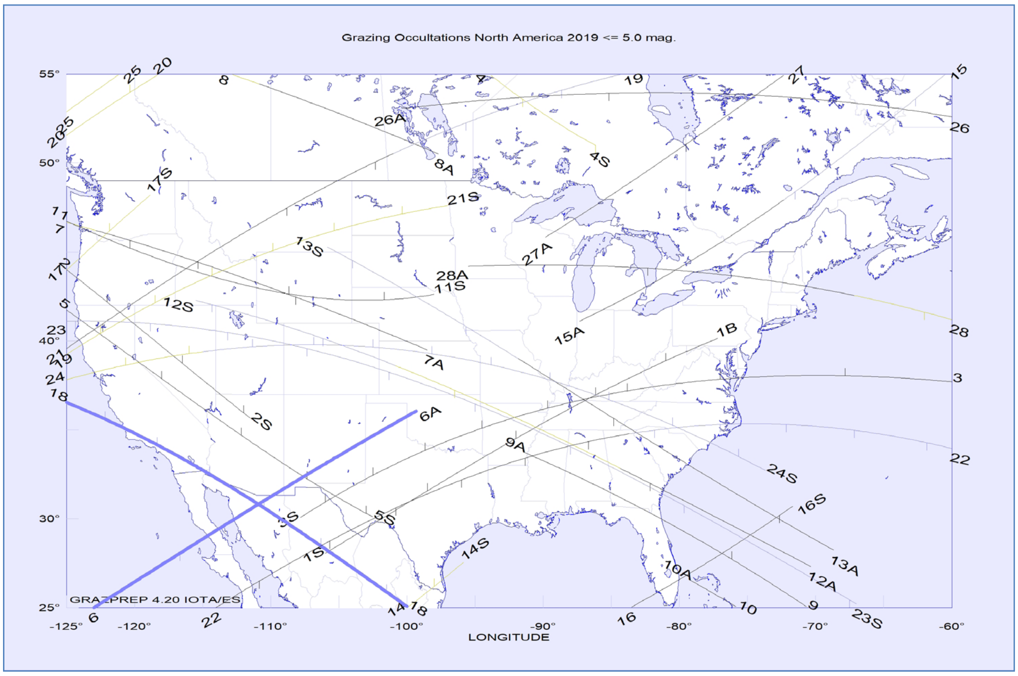
Nighttime events along the dark lunar limb are shown with a black line, whereas those events at night at the sunlit lunar limb are given in yellow. All daytime events appear in light blue. Events of stars or planets of mag.1.5 or brighter are highlighted with a bold line.

Tick marks appear along the limit lines every full 10 minutes of time. The northern limb grazes show tick marks pointing downwards, whereas on the southern limb grazes they point upwards.

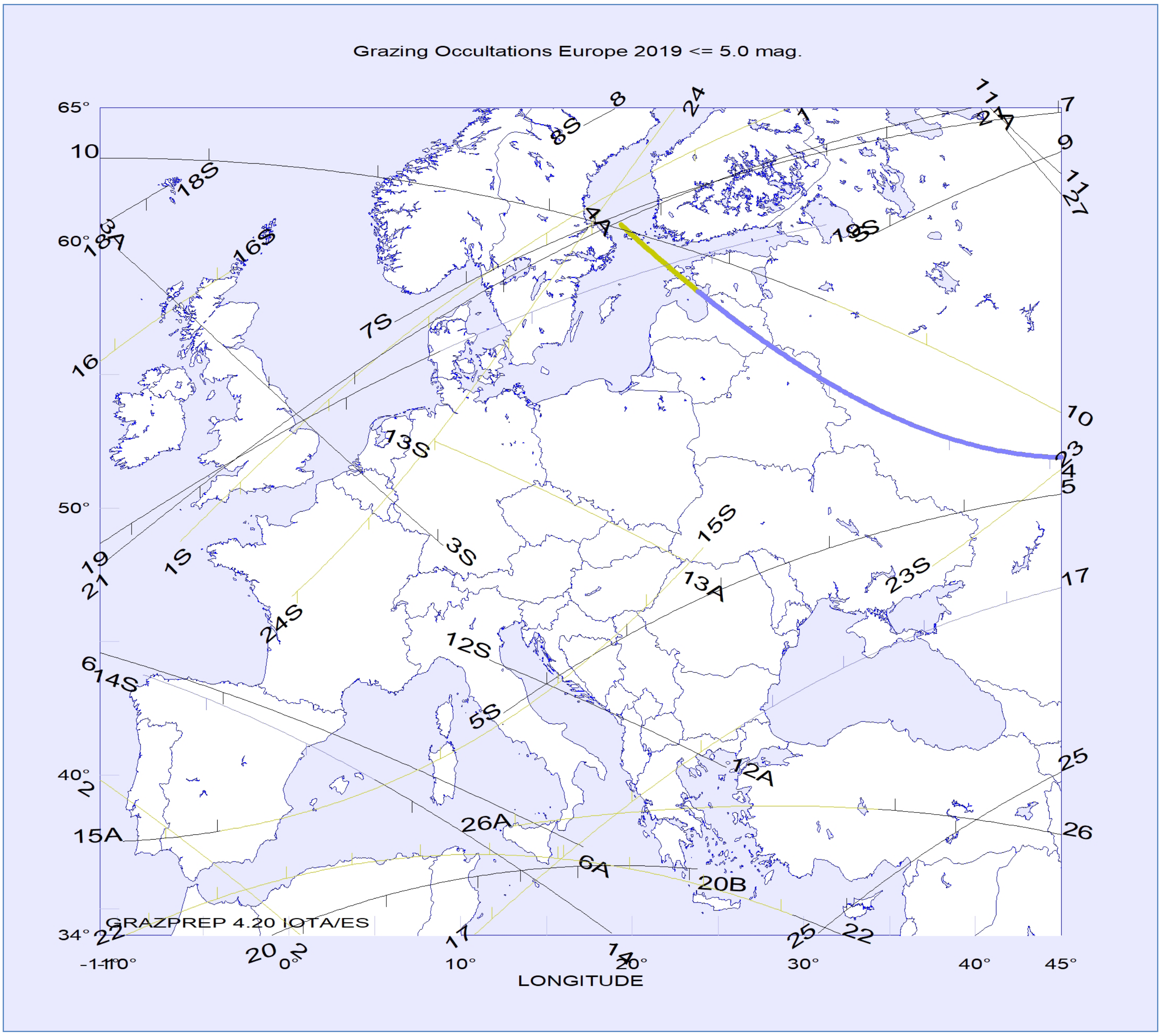
All tables and pictures of this article were created with the author's GRAZPREP-software. Further precise information on the local circumstances of all grazing occultations is provided by this software which can be downloaded and installed via www.grazprep.com (password: IOTA/ES) including prediction files that are needed additionally for different regions of the world. GRAZPREP assists in finding and listing individually favourable occultation events and in figuring out the best observing site in advance or even under way by graphically showing the expected apparent stellar path through the lunar limb terrain. Most stars (fainter than mag. 3) are calculated with their highly precise position of the Gaia-catalogue.

2019 — Grazing Occultations North America 2019 <= 5.0 mag. — GRAZPREP 4.20, IOTA/ES

No.	M D	USNO	SAOPPM D	MAG	%SNL	L.	W.UT	LONG	LAT	STAR NAME	MAG1	MAG2
1	Jan 19	ZC 894	77705	4.4	93+	S	0 31.0	-106	28	chi 1 Orionis		
2	Jan 29	ZC 2271	159563 X	4.1	33 -	S	14 5.4	-125	44	theta Librae	5.1	5.1
3	Feb 12	ZC 405	110723 V	4.3	40+	S	0 54.7	-108	30	mu Ceti	4.5	8.5
4	Feb 26	ZC 2361	159918	4.2	50 -	N	12 26.3	-94	55	chi Ophiuchi	4.2	5.0
5	Feb 27	ZC 2498	185296	4.4	40 -	S	12 41.6	-125	42	xi Ophiuchi NSV 21541		
6	Mar 01			0.8	20 -	N	19 42.2	-123	25	Saturn		
7	Mar 13	ZC 648	93897 L	3.8	37+	N	6 11.9	-125	47	Hyadum II delta 1 Tauri	3.9	9.5
8	Mar 13	ZC 653	93907 X	4.8	37+	N	6 34.2	-112	55	64 delta 2 Tauri	5.6	5.6
9	Mar 25	ZC 2271	159563 X	4.1	78 -	S	4 52.9	-91	34	theta Librae	5.1	5.1
10	Mar 27	ZC 2547	185660 X	4.9	59 -	S	5 47.8	-79	27	58 Ophiuchi	5.1	6.9
11	Apr 27	ZC 3078	189986 M	4.9	46 -	S	11 8.3	-125	47	Chow eta Capricorni	5.0	7.4
12	May 08	ZC 847	77336 J	3.0	10+	N	1 18.6	-115	42	zeta Tauri	3.2	5.2
13	Jun 06	ZC 1110	79294 O	3.5	8+	N	1 7.7	-106	45	Wasat delta Geminorum	3.5	8.2
14	Jun 28	ZC 405	110723 V	4.3	22 -	S	11 26.2	-100	25	mu Ceti	4.5	8.5
15	Jun 30	ZC 648	93897 L	3.8	7 -	N	8 51.7	-87	41	Hyadum II delta 1 Tauri	3.9	9.5
16	Jun 30	ZC 658	93923 T	4.3	7 -	N	9 41.6	-83	25	68 Tauri V776 Tauri	4.3	8.4
17	Jul 25	ZC 364	110543	4.3	46 -	S	12 12.5	-125	44	xi 2 Ceti		
18	Jul 31			-3.5	0 -	S	21 2.6	-125	37	Venus		
19	Aug 25	ZC 847	77336 J	3.0	31 -	N	11 16.7	-125	40	zeta Tauri	3.2	5.2
20	Sep 20	ZC 648	93897 L	3.8	68 -	S	9 51.6	-125	52	Hyadum II delta 1 Tauri	3.9	9.5
21	Sep 20	ZC 658	93923 T	4.3	67 -	S	11 13.9	-125	39	68 Tauri V776 Tauri	4.3	8.4
22	Sep 22	ZC 946	78135 Q	3.5	47 -	N	10 24.7	-114	25	Propus eta Geminorum	3.4	5.4
23	Sep 22	ZC 976	78297 A	2.9	45 -	N	14 58.9	-125	41	Tejat Posterior mu Geminorum	3.2	9.8
24	Sep 23	ZC 1110	79294 O	3.5	35 -	S	13 11.5	-125	38	Wasat delta Geminorum	3.5	8.2
25	Oct 08	ZC 3078	189986 M	4.9	74+	N	6 54.0	-125	53	Chow eta Capricorni	5.0	7.4
26	Oct 25	ZC 1702	119035	4.0	11 -	N	9 58.3	-100	53	nu Virginis		
27	Nov 16	ZC 976	78297 A	2.9	87 -	N	1 16.9	-90	46	Tejat Posterior mu Geminorum	3.2	9.8
28	Nov 22	ZC 1773	119341 V	5.0	23 -	N	8 48.1	-95	44	16 Virginis	5.8	5.8

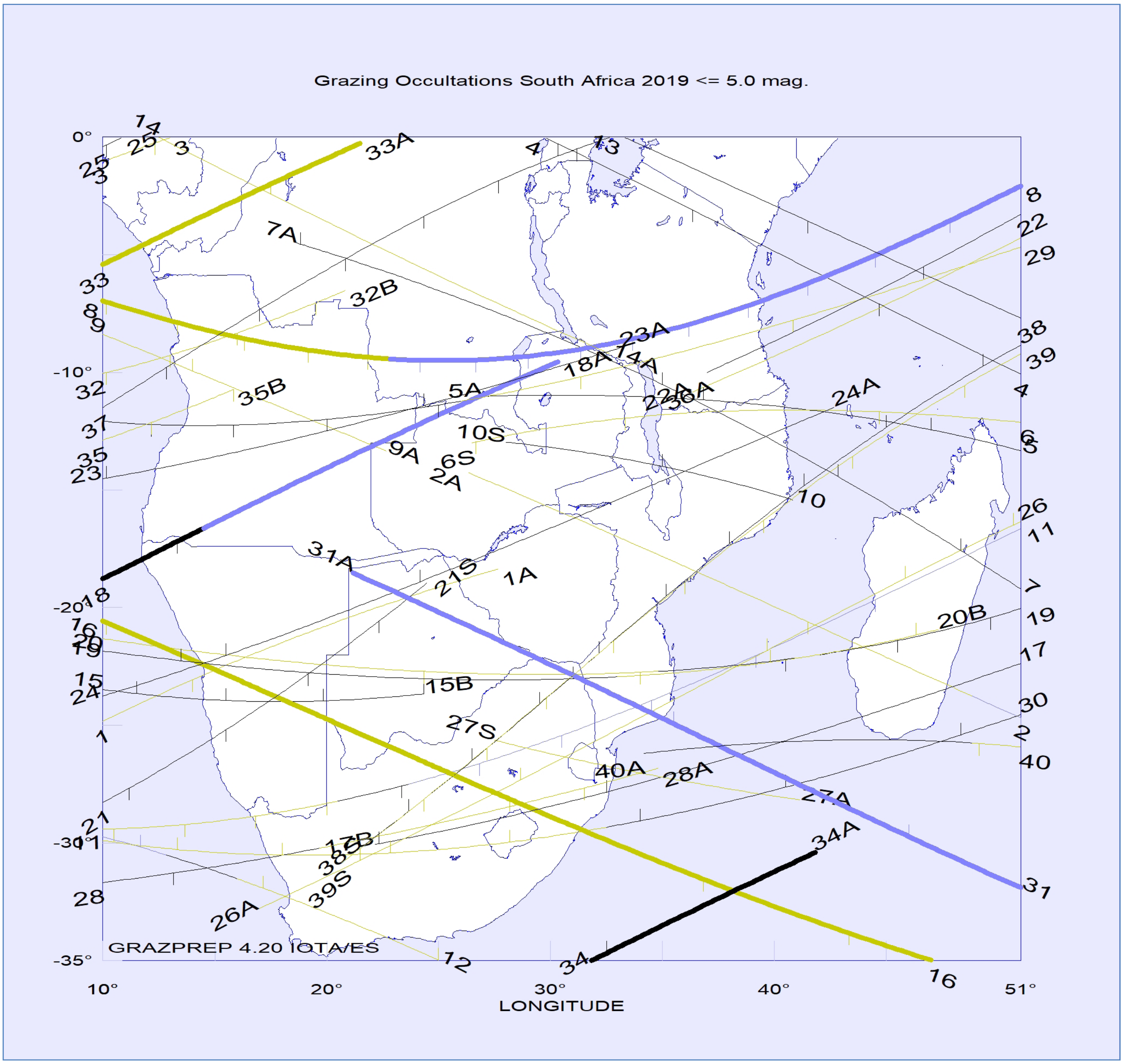


2019	Grazing Occultations Europe 2019 <= 5.0 mag.									GRAZPREP 4.20, IOTA/ES	
No.	M D	USNO	SAOPPM D	MAG	%SNL	L.	W.UT	LONG LAT	STAR NAME	MAG1	MAG2
1	**Jan 15**	ZC 405	110723 V	4.3	65+	N	16 53.1	-6 49	mu Ceti	4.5	8.5
2	**Jan 29**	ZC 2223	159370 T	3.9	36 -	N	4 27.4	-11 40	Zuben Elakrab gamma Librae	4.7	4.9
3	**Jan 31**	ZC 2498	185296	4.4	18 -	S	6 46.0	-10 60	xi Ophiuchi NSV 21541		
4	**Feb 02**			0.8	6 -	N	6 31.8	19 61	Saturn		
5	**Feb 11**	ZC 364	110543	4.3	37+	S	16 34.6	12 42	xi 2 Ceti		
6	**Feb 14**	ZC 653	93907 X	4.8	60+	N	0 5.2	-11 45	64 delta 2 Tauri	5.6	5.6
7	**Feb 14**	ZC 764	94332 O	4.9	69+	S	16 34.1	6 57	104 Tauri	5.6	5.6
8	**Feb 15**	ZC 915	77911 L	4.6	79+	S	15 21.2	17 64	chi 2 Orionis	5.5	6.3
9	**Feb 16**	ZC 1077	79031 B	4.0	88+	S	14 29.2	34 60	Mekbuda zeta Geminorum	4.5	4.5
10	**Mar 14**	ZC 894	77705	4.4	54+	S	20 3.6	-11 63	chi 1 Orionis		
11	**Mar 16**	ZC 1077	79031 B	4.0	67+	S	0 36.7	40 65	Mekbuda zeta Geminorum	4.5	4.5
12	**May 06**	ZC 653	93907 X	4.8	3+	S	18 23.1	11 44	64 delta 2 Tauri	5.6	5.6
13	**May 06**	ZC 658	93923 T	4.3	3+	N	18 56.5	8 53	68 Tauri V776 Tauri	4.3	8.4
14	**May 09**	ZC 1110	79294 O	3.5	25+	N	18 14.0	-8 44	Wasat delta Geminorum	3.5	8.2
15	**Jun 26**	ZC 118	129009	4.8	43 -	S	1 38.7	-9 38	20 Ceti		
16	**Aug 22**	ZC 405	110723 V	4.3	64 -	S	4 38.5	-11 55	mu Ceti	4.5	8.5
17	**Aug 24**	ZC 648	93897 L	3.8	44 -	S	2 57.8	10 34	Hyadum II delta 1 Tauri	3.9	9.5
18	**Aug 24**	ZC 658	93923 T	4.3	44 -	N	4 56.5	-11 61	68 Tauri V776 Tauri	4.3	8.4
19	**Aug 27**	ZC 1110	79294 O	3.5	14 -	N	4 8.8	-11 49	Wasat delta Geminorum	3.5	8.2
20	**Nov 14**	ZC 668	93954	3.5	98 -	N	1 26.1	-1 34	Ain epsilon Tauri		
21	**Nov 15**	ZC 946	78135 Q	3.5	88 -	N	21 54.5	-11 48	Propus eta Geminorum	3.4	5.4
22	**Nov 16**	ZC 976	78297 A	2.9	87 -	S	1 37.1	-9 34	Tejat Posterior mu Geminorum	3.2	9.8
23	**Nov 28**	ZC 2589	186061	4.7	4+	S	13 41.3	37 48	4 Sagittarii		
24	**Dec 05**	ZC 3536	147042	4.4	63+	N	16 9.4	0 47	30 Piscium YY Piscium	4.4	4.4
25	**Dec 05**	ZC 5	128572 L	4.6	64+	S	19 16.9	30 34	33 Piscium BC Piscium	5.0	7.5
26	**Dec 18**	ZC 1702	119035	4.0	51 -	S	23 0.7	13 38	nu Virginis		
27	**Dec 24**	ZC 2353	159892	4.5	4 -	S	5 43.8	42 64	psi Ophiuchi		


Grazing Occultations Europe 2019 <= 5.0 mag.
GRAZPREP 4.20 IOTA/ES
LONGITUDE
65°
60°
50°
40°
34°
-10°
0°
10°
20°
30°
40°
45°

Europe

2019				Grazing Occultations South Africa 2019 <= 5.0 mag.						GRAZPREP 4.20, IOTA/ES	
No.	**M D**	**USNO**	**SAOPPM D**	**MAG**	**%SNL**	**L.**	**W.UT**	**LONG LAT**	**STAR NAME**	**MAG1**	**MAG2**
1	**Jan 09**	ZC 3237	164861 V	4.3	11+	N	18 56.5	10 -25	iota Aquarii	5.2	5.2
2	**Feb 02**	ZC 2759	187504	3.5	6 -	N	2 14.0	26 -14	xi 2 Sagittarii		
3	**Feb 10**	ZC 249	110065	4.5	28+	N	18 25.6	10 -1	nu Piscium		
4	**Feb 16**	ZC 1110	79294 O	3.5	89+	N	22 19.4	30 0	Wasat delta Geminorum	3.5	8.2
5	**Feb 21**	ZC 1773	119341 V	5.0	92 -	S	18 45.8	27 -11	16 Virginis	5.8	5.8
6	**Mar 10**	ZC 327	110408 K	4.4	15+	N	16 30.0	26 -13	xi 1 Ceti NSV 00749	5.3	5.3
7	**Mar 24**	ZC 2223	159370 T	3.9	80 -	S	20 20.7	18 -5	Zuben Elakrab gamma Librae	4.7	4.9
8	**Mar 29**			0.8	40 -	N	3 50.4	10 -7	Saturn		
9	**Apr 10**	ZC 847	77336 J	3.0	28+	S	20 17.7	10 -8	zeta Tauri	3.2	5.2
10	**Apr 17**	ZC 1773	119341 V	5.0	96+	S	16 2.6	28 -13	16 Virginis	5.8	5.8
11	**Apr 25**	ZC 2779	187643	3.8	67 -	N	4 8.5	10 -29	omicron Sagittarii NSV 11703		
12	**May 08**	ZC 946	78135 Q	3.5	15+	S	16 16.7	10 -30	Propus eta Geminorum	3.4	5.4
13	**May 08**	ZC 946	78135 Q	3.5	15+	N	17 3.3	33 0	Propus eta Geminorum	3.4	5.4
14	**May 09**	ZC 1110	79294 O	3.5	25+	S	19 25.5	12 0	Wasat delta Geminorum	3.5	8.2
15	**May 21**	ZC 2547	185660 X	4.9	95 -	S	1 26.5	10 -23	58 Ophiuchi	5.1	6.9
16	**May 22**			0.5	83 -	N	20 30.5	10 -21	Saturn		
17	**Jun 16**	ZC 2361	159918	4.2	98+	S	1 20.6	22 -30	chi Ophiuchi	4.2	5.0
18	**Jun 19**			0.3	97 -	N	5 26.9	10 -19	Saturn		
19	**Jun 23**	ZC 3425	146620 K	4.4	63 -	N	22 33.2	10 -21	psi 2 Aquarii	5.4	5.4
20	**Jun 23**	ZC 3428	146635 A	5.0	63 -	S	22 49.3	10 -22	psi 3 Aquarii NSV 14491	5.2	11.2
21	**Jun 27**	ZC 249	110065	4.5	32 -	N	4 17.8	10 -28	nu Piscium		
22	**Jul 29**	ZC 847	77336 J	3.0	12 -	S	1 14.3	36 -11	zeta Tauri	3.2	5.2
23	**Aug 08**	ZC 2271	159563 X	4.1	62+	S	22 20.5	10 -15	theta Librae	5.1	5.1
24	**Aug 10**	ZC 2547	185660 X	4.9	81+	S	23 12.2	10 -24	58 Ophiuchi	5.1	6.9
25	**Aug 26**	ZC 946	78135 Q	3.5	24 -	N	2 0.4	10 0	Propus eta Geminorum	3.4	5.4
26	**Aug 26**	ZC 946	78135 Q	3.5	24 -	S	2 6.7	17 -33	Propus eta Geminorum	3.4	5.4
27	**Aug 31**	ZC 1702	119035	4.0	2+	S	15 54.4	27 -26	nu Virginis		
28	**Sep 04**	ZC 2223	159370 T	3.9	35+	N	20 27.2	10 -32	Zuben Elakrab gamma Librae	4.7	4.9
29	**Sep 05**	ZC 2361	159918	4.2	46+	N	18 43.8	10 -12	chi Ophiuchi	4.2	5.0
30	**Sep 06**	ZC 2498	185296	4.4	57+	S	18 12.5	10 -30	xi Ophiuchi NSV 21541		
31	**Sep 08**			0.6	75+	S	12 4.3	21 -19	Saturn		
32	**Oct 05**	ZC 2747	187426 A	4.9	51+	N	18 29.8	10 -10	Ain Al Rami nu 1 Sagittarii	5.0	10.8
33	**Oct 05**			0.7	51+	N	22 26.0	10 -5	Saturn		
34	**Oct 05**			0.7	51+	S	21 59.7	32 -35	Saturn		
35	**Oct 05**	ZC 2749	187445 V	5.0	51+	N	19 13.8	10 -13	Ain Al Rami nu 2 Sagittarii	5.8	5.8
36	**Oct 18**	ZC 817	77184 T	4.9	76 -	N	19 45.9	37 -10	omicron Tauri	5.6	5.6
37	**Nov 14**	ZC 792	77097	5.0	94 -	N	22 34.4	10 -11	109 Tauri		
38	**Dec 04**	ZC 3428	146635 A	5.0	54+	S	17 24.1	21 -30	psi 3 Aquarii NSV 14491	5.2	11.2
39	**Dec 04**	ZC 3425	146620 K	4.4	54+	N	17 27.2	20 -31	psi 2 Aquarii	5.4	5.4
40	**Dec 18**	ZC 1701	119029	4.8	52 -	N	22 13.7	34 -26	xi Virginis		

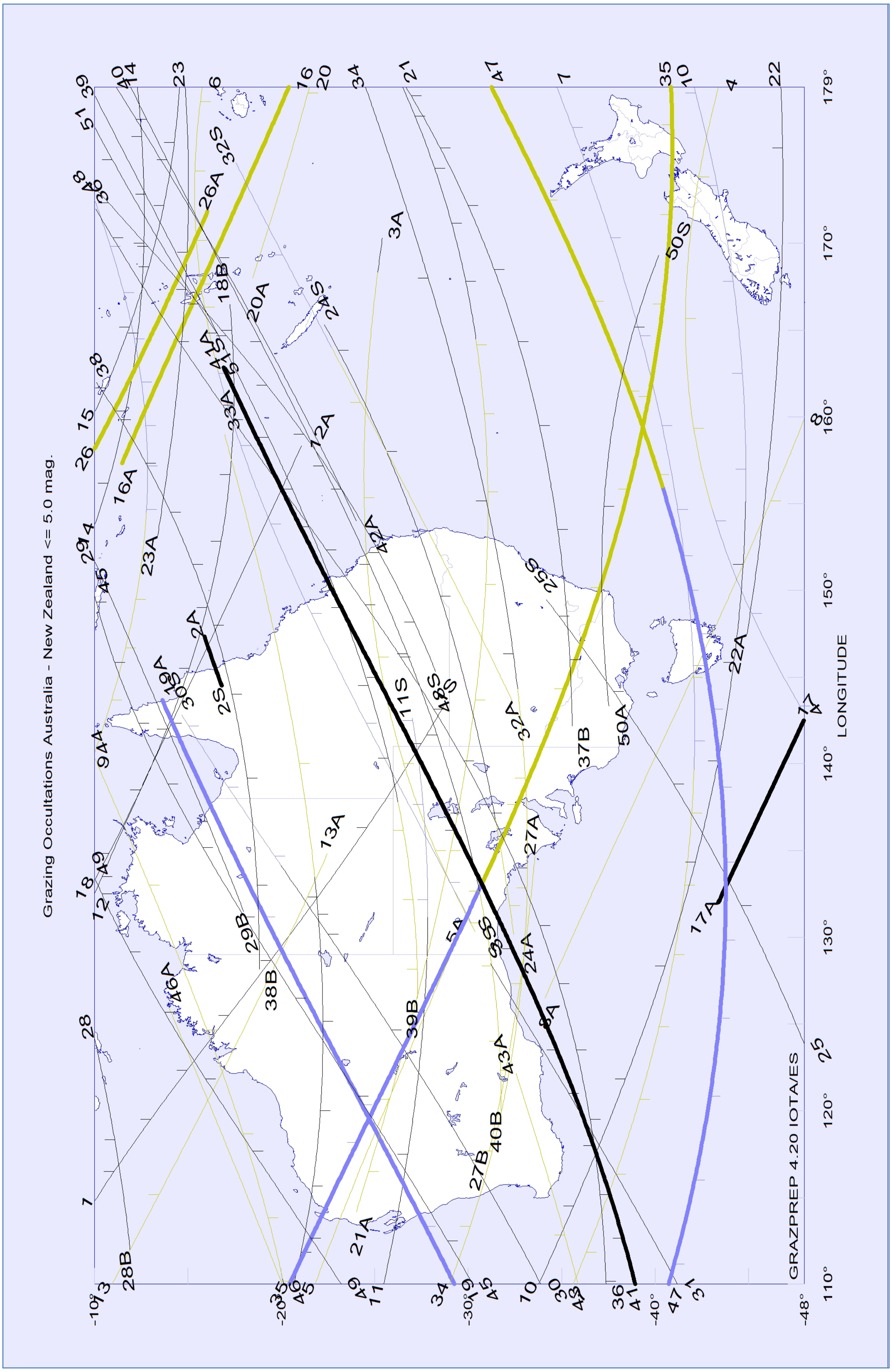


South Africa

Australia

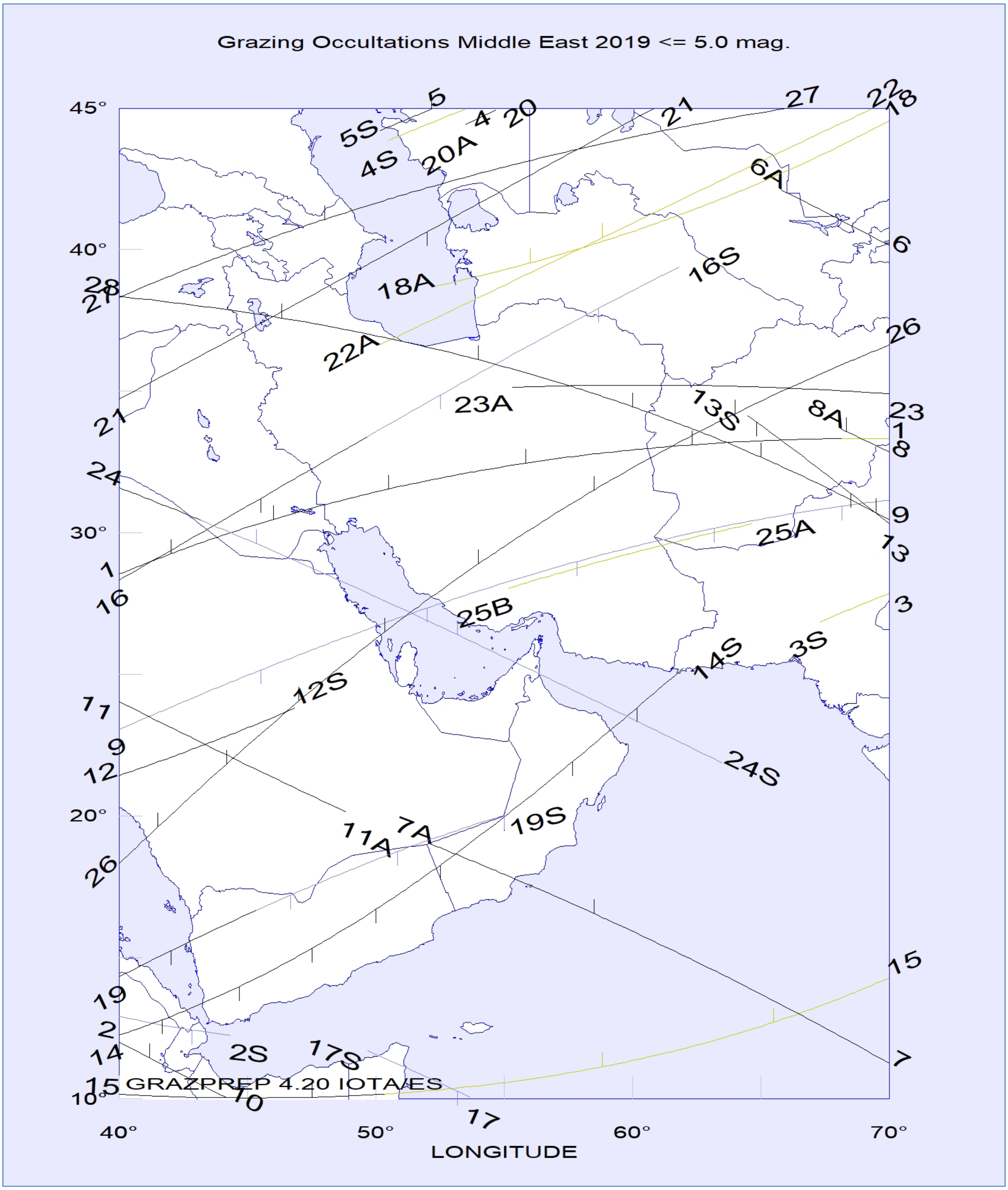
2019 — Grazing Occultations Australia - New Zealand 2019 <= 5.0 mag. GRAZPREP 4.20, IOTA/ES

No.	M D	USNO	SAOPPM D	MAG	%SNL	L.	W.UT	LONG LAT	STAR NAME	MAG1	MAG2
1	Jan 24	ZC 1702	119035	4.0	82 -	S	18 34.7	114 -10	nu Virginis		
2	Feb 05			-1.4	0+	S	8 55.0	144 -17	Mercury		
3	Feb 11	ZC 327	110408 K	4.4	35+	N	10 8.9	130 -30	xi 1 Ceti NSV 00749	5.3	5.3
4	Mar 13	ZC 668	93954	3.5	39+	N	7 39.6	143 -48	Ain epsilon Tauri		
5	Mar 14	ZC 847	77336 J	3.0	52+	S	14 21.1	110 -22	zeta Tauri	3.2	5.2
6	Mar 15	ZC 976	78297 A	2.9	60+	N	6 28.4	130 -30	Tejat Posterior mu Geminorum	3.2	9.8
7	Mar 27	ZC 2633	186497 T	3.8	53 -	N	19 46.2	110 -36	mu Sagittarii	4.1	7.0
8	Mar 28	ZC 2759	187504	3.5	45 -	N	15 22.0	126 -34	xi 2 Sagittarii		
9	Mar 28	ZC 2779	187643	3.8	43 -	N	19 1.4	140 -10	omicron Sagittarii NSV 11703		
10	Mar 28	ZC 2779	187643	3.8	43 -	S	18 44.7	110 -34	omicron Sagittarii NSV 11703		
11	Mar 31	ZC 3171	164560 V	3.7	17 -	S	21 3.1	110 -25	Nashira gamma Capricorni	4.6	4.6
12	Apr 11	ZC 946	78135 Q	3.5	36+	N	11 18.6	132 -10	Propus eta Geminorum	3.4	5.4
13	Apr 12	ZC 1110	79294 O	3.5	48+	S	13 53.6	110 -11	Wasat delta Geminorum	3.5	8.2
14	Apr 21	ZC 2271	159563 X	4.1	93 -	S	16 43.9	154 -10	theta Librae	5.1	5.1
15	Apr 23	ZC 2547	185660 X	4.9	80 -	S	15 36.4	160 -10	58 Ophiuchi	5.1	6.9
16	Apr 25			0.7	63 -	N	12 37.2	157 -11	Saturn		
17	Apr 25			0.7	63 -	S	13 13.3	132 -43	Saturn		
18	May 20	ZC 2498	185296	4.4	96 -	S	14 56.0	133 -10	xi Ophiuchi NSV 21541		
19	May 22			0.5	83 -	N	23 34.2	110 -29	Saturn		
20	May 25	ZC 3171	164560 V	3.7	61 -	N	12 6.5	168 -18	Nashira gamma Capricorni	4.6	4.6
21	May 25	ZC 3190	164644 J	2.9	59 -	N	15 39.7	114 -24	Deneb Algedi delta Capricorni	3.2	5.2
22	May 27	ZC 3425	146620 K	4.4	41 -	S	14 51.6	147 -45	psi 2 Aquarii	5.4	5.4
23	May 27	ZC 3428	146635 A	5.0	41 -	S	14 54.5	153 -13	psi 3 Aquarii NSV 14491	5.2	11.2
24	May 30	ZC 249	110065	4.5	14 -	N	18 59.7	130 -32	nu Piscium		
25	Jun 27	ZC 327	110408 K	4.4	26 -	N	20 32.1	124 -48	xi 1 Ceti NSV 00749	5.3	5.3
26	Jul 04			1.8	3+	S	7 21.9	158 -10	Mars		
27	Jul 08	ZC 1773	119341 V	5.0	40+	S	13 46.8	117 -31	16 Virginis	5.8	5.8
28	Jul 12	ZC 2271	159563 X	4.1	83+	S	16 42.7	112 -12	theta Librae	5.1	5.1
29	Jul 14	ZC 2547	185660 X	4.9	95+	S	17 44.9	131 -18	58 Ophiuchi	5.1	6.9
30	Jul 27	ZC 668	93954	3.5	22 -	N	21 4.0	110 -34	Ain epsilon Tauri		
31	Jul 28	ZC 817	77184 T	4.9	13 -	N	22 2.6	110 -41	omicron Tauri	5.6	5.6
32	Jul 29	ZC 976	78297 A	2.9	7 -	S	19 33.0	143 -32	Tejat Posterior mu Geminorum	3.2	9.8
33	Aug 08	ZC 2223	159370 T	3.9	59+	N	12 55.1	110 -21	Zuben Elakrab gamma Librae	4.7	4.9
34	Aug 09	ZC 2361	159918	4.2	69+	S	11 51.9	110 -29	chi Ophiuchi	4.2	5.0
35	Aug 12			0.4	91+	S	8 16.5	110 -20	Saturn		
36	Aug 15	ZC 3190	164644 J	2.9	100 -	N	14 9.9	110 -37	Deneb Algedi delta Capricorni	3.2	5.2
37	Aug 17	ZC 3419	146598 A	4.2	96 -	N	11 46.0	142 -36	psi 1 Aquarii	4.5	8.5
38	Aug 17	ZC 3425	146620 K	4.4	96 -	N	12 34.1	128 -19	psi 2 Aquarii	5.4	5.4
39	Sep 08	ZC 2747	187426 A	4.9	73+	S	11 16.2	126 -27	Ain Al Rami nu 1 Sagittarii	5.0	10.8
40	Sep 08	ZC 2749	187445 V	5.0	74+	S	11 40.7	120 -32	Ain Al Rami nu 2 Sagittarii	5.8	5.8
41	Sep 08			0.6	75+	S	14 14.9	110 -39	Saturn		
42	Sep 21	ZC 817	77184 T	4.9	55 -	N	14 11.5	154 -24	omicron Tauri	5.6	5.6
43	Oct 02	ZC 2271	159563 X	4.1	19+	S	13 29.1	110 -36	theta Librae	5.1	5.1
44	Oct 04	ZC 2547	185660 X	4.9	38+	N	12 1.0	110 -20	58 Ophiuchi	5.1	6.9
45	Oct 18	ZC 792	77097	5.0	78 -	N	16 37.9	110 -30	109 Tauri		
46	Oct 31	ZC 2498	185296	4.4	14+	N	12 20.4	110 -20	xi Ophiuchi NSV 21541		
47	Nov 02			0.8	30+	N	6 28.0	110 -41	Saturn		
48	Nov 07	ZC 3428	146635 A	5.0	77+	S	8 44.0	145 -28	psi 3 Aquarii NSV 14491	5.2	11.2
49	Nov 14	ZC 752	76920 K	4.6	95 -	N	15 35.4	110 -23	iota Tauri	5.4	5.4
50	Nov 21	ZC 1701	119029	4.8	30 -	N	16 55.6	143 -38	xi Virginis		
51	Dec 29	ZC 3078	189986 M	4.9	10+	S	7 37.2	164 -17	Chow eta Capricorni	5.0	7.4


Grazing Occultations Australia - New Zealand <= 5.0 mag.
GRAZPREP 4.20 IOTA/ES
LONGITUDE

2019			Grazing Occultations Middle East 2019 <= 5.0 mag.								GRAZPREP 4.20, IOTA/ES	
No.	M D	USNO	SAOPPM D	MAG	%SNL	L.	W.UT	LONG	LAT	STAR NAME	MAG1	MAG2
1	**Jan 15**	ZC 405	110723 V	4.3	65+	S	17 44.9	40	29	mu Ceti	4.5	8.5
2	**Jan 29**	ZC 2223	159370 T	3.9	36 -	N	6 31.8	40	13	Zuben Elakrab gamma Librae	4.7	4.9
3	**Feb 07**	ZC 3419	146598 A	4.2	6+	N	13 14.2	67	27	psi 1 Aquarii	4.5	8.5
4	**Feb 07**	ZC 3425	146620 K	4.4	6+	N	13 54.6	50	44	psi 2 Aquarii	5.4	5.4
5	**Feb 07**	ZC 3428	146635 A	5.0	6+	S	13 58.3	50	44	psi 3 Aquarii NSV 14491	5.2	11.2
6	**Feb 27**	ZC 2547	185660 X	4.9	34 -	S	22 38.8	66	42	58 Ophiuchi	5.1	6.9
7	**Mar 25**	ZC 2361	159918	4.2	72 -	S	19 28.0	52	19	chi Ophiuchi	4.2	5.0
8	**Mar 26**	ZC 2498	185296	4.4	62 -	S	19 50.9	68	34	xi Ophiuchi NSV 21541		
9	**Apr 12**	ZC 1110	79294 O	3.5	48+	N	11 12.8	40	23	Wasat delta Geminorum	3.5	8.2
10	**Apr 24**	ZC 2747	187426 A	4.9	68 -	S	21 58.9	40	12	Ain Al Rami nu 1 Sagittarii	5.0	10.8
11	**May 09**	ZC 1110	79294 O	3.5	25+	N	19 17.1	40	24	Wasat delta Geminorum	3.5	8.2
12	**Jun 01**	ZC 405	110723 V	4.3	6 -	S	2 4.3	40	21	mu Ceti	4.5	8.5
13	**Jun 10**	ZC 1702	119035	4.0	55+	N	14 49.5	64	34	nu Virginis		
14	**Jun 23**	ZC 3428	146635 A	5.0	63 -	N	23 45.3	40	12	psi 3 Aquarii NSV 14491	5.2	11.2
15	**Jun 24**	ZC 3536	147042	4.4	54 -	S	21 47.3	40	10	30 Piscium YY Piscium	4.4	4.4
16	**Jul 29**	ZC 847	77336 J	3.0	12 -	N	1 43.8	40	28	zeta Tauri	3.2	5.2
17	**Aug 08**	ZC 2223	159370 T	3.9	59+	N	10 28.2	49	12	Zuben Elakrab gamma Librae	4.7	4.9
18	**Aug 21**	ZC 364	110543	4.3	67 -	S	18 49.3	52	39	xi 2 Ceti		
19	**Aug 26**	ZC 946	78135 Q	3.5	24 -	N	2 36.0	40	14	Propus eta Geminorum	3.4	5.4
20	**Sep 21**	ZC 847	77336 J	3.0	53 -	N	18 47.6	53	44	zeta Tauri	3.2	5.2
21	**Oct 19**	ZC 976	78297 A	2.9	67 -	N	19 32.8	40	35	Tejat Posterior mu Geminorum	3.2	9.8
22	**Oct 20**	ZC 1110	79294 O	3.5	57 -	S	19 8.1	50	37	Wasat delta Geminorum	3.5	8.2
23	**Oct 26**	ZC 1773	119341 V	5.0	6 -	N	0 33.4	55	35	16 Virginis	5.8	5.8
24	**Nov 16**	ZC 976	78297 A	2.9	87 -	S	3 31.9	40	32	Tejat Posterior mu Geminorum	3.2	9.8
25	**Dec 04**	ZC 3428	146635 A	5.0	54+	N	19 25.5	55	28	psi 3 Aquarii NSV 14491	5.2	11.2
26	**Dec 05**	ZC 3536	147042	4.4	63+	S	16 34.7	40	18	30 Piscium YY Piscium	4.4	4.4
27	**Dec 05**	ZC 5	128572 L	4.6	64+	S	19 31.6	40	38	33 Piscium BC Piscium	5.0	7.5
28	**Dec 18**	ZC 1702	119035	4.0	51 -	S	23 13.8	40	38	nu Virginis		

Middle


Grazing Occultations Middle East 2019 <= 5.0 mag.
45°
40°
30°
20°
10°
40°
50°
60°
70°
LONGITUDE
GRAZPREP 4.20 IOTA/ES

East

Bradley Wells Timerson

*February 24, 1950 † October 17, 2018

Place of Birth: Geneva, New York
Place of Death: Clifton Springs, New York
Residence: Newark, New York
Age: 68

Bradley Wells Timerson, 68, died on Wednesday, October 17, 2018. He was born on February 24, 1950 in Geneva, New York. One of Brad's greatest passions in life was astronomy. At a young age all Brad wanted for Christmas was a Telescope and his parents cultivated this passion by giving him his first telescope. That telescope would play such a large part in his life.

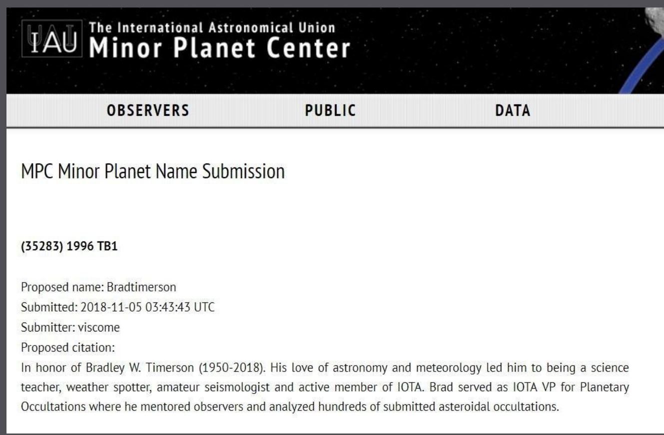
His love for Astronomy/Meteorology led him to a career of teaching high school science. He has always been Mr. Science to his students. In his work as a teacher at Newark Central School District for over 30 years, Brad taught Earth Science, Physics, Astronomy and Meteorology, served as the Science Department Chairperson, and spearheaded countless science projects that harnessed the imaginations of the students and staff that he worked with. Many students probably remember his observatory at his home in Newark to get a closer look at the Moon, planets and stars.

He was an active weather spotter for several local news stations, and kept records of the weather at his home location for many years.

Path through snow to Brad's observatory – note the meter stick to measure the snow depth. (C. Timerson)

Another science interest Brad had was measuring earthquakes with his in-home seismograph. Ted Blank in the United States had a side story regarding Brad's seismic interest:

"In the early 80's I was part of a group of amateur seismology enthusiasts, building earthquake sensors and recording events from around the world in our basements and garages. I wrote some software to record the quake data on a PC and made the program available on a bulletin board (Compuserve?). The first request for my software came from a Brad Timerson who was teaching in the Newark, NY schools. He ran my software on a PC in his classroom for many years and introduced his students to Geology in the best way possible, by letting them record and view their own earthquake data. Fast-forward 25 years to my first IOTA meeting in Cambridge, Massachusetts. I start hearing about a guy named Brad Timerson who is coordinating all of our asteroid observations, and sure enough it's my old friend. I used to kid him that he and I could not seem to decide whether to do our scientific work looking down or looking up."


IAU The International Astronomical Union Minor Planet Center

OBSERVERS | PUBLIC | DATA

MPC Minor Planet Name Submission

(35283) 1996 TB1

Proposed name: Bradtimerson
Submitted: 2018-11-05 03:43:43 UTC
Submitter: viscome
Proposed citation:
In honor of Bradley W. Timerson (1950-2018). His love of astronomy and meteorology led him to being a science teacher, weather spotter, amateur seismologist and active member of IOTA. Brad served as IOTA VP for Planetary Occultations where he mentored observers and analyzed hundreds of submitted asteroidal occultations.

MPC Minor Planet name submission by George Viscome for a minor planet bearing Brad Timerson's name.

In retirement, Brad continued to contribute to the scientific community through his astronomical photography, and weather spotting. He began observing lunar occultations in the late 1960's. Soon he was helping David Dunham with the predicting of lunar occultations and sending out printed copies to IOTA members. Ultimately, he observed 186 individual lunar occultations. Then, along came asteroidal occultations. His first positive asteroidal occultation was in 2004. Since then, the Occult4 database shows Brad had 31 positive asteroidal occultation observations. It was 2006, the same year he became the North American Coordinator, that he recorded an occultation by Phocaea and realized IOTA needed a better way to report occultations. Too many times, crucial information was missing from emailed reports. The Excel report Form was born and, with the help of John Talbot, became a useful tool for reporting occultations. The Form remains a useful tool for reporting asteroidal occultations with accuracy and with all the required observational information. Brad continued serving as the North American Regional Coordinator for IOTA – serving in the position for more than 12 years. In 2017, Brad (and other Regional Coordinators) was recognized with the Homer F. DaBoll Award from IOTA in recognition for his outstanding service.

George Viscome, discoverer of several asteroids has submitted 'Bradtimerson' to the Minor Planet Center for the name of asteroid (35283) 1996 TB1. The name is pending approval by the Minor Planet Center. It will be fitting that some day an IOTA member gets the first occultation of a star by asteroid 'Bradtimerson'.

Brad is survived by his wife of 46 years, Cynthia Freelove Timerson, His children Michael (Katelyn) of Harrisburg, NC and Rebecca (David) Schusler of Huntersville, NC; two grandchildren Elijah and Brinley and one on the way; a brother Carlton (Patricia) of Newark and sister Mary (Michael) Cook of Waterloo; an aunt Carol (Lee) Wilson of Phelps; nieces, nephews, cousins and many friends.

Memorials, in his name, may be made to the Bradley Wells Timerson Scholarship Fund, at Newark Central School District, 100 East Miller Street, Newark, New York 14513.

Tony George, IOTA

Beyond Jupiter
The World of Distant Minor Planets

Since the downgrading of Pluto in 2006 by the IAU, the planet Neptune marks the end of the zone of planets. Beyond Neptune, the world of icy large and small bodies, with and without an atmosphere (called Trans Neptunian Objects or *TNOs*) starts. This zone between Jupiter and Neptune is also host to mysterious objects, namely the Centaurs and the Neptune Trojans. All of these groups are summarized as "distant minor planets". Occultation observers investigate these members of our solar system, without ever using a spacecraft. The sheer number of these minor planets is huge. As of December 2018, the *Minor Planet Center* listed 856 Centaurs and 2442 TNOs.

In the coming years, JOA wants to portray a member of this world in every issue; needless to say not all of them will get an article here. The table shows you where to find the objects presented in former JOA issues. (KG).

No.	Name	Author	Issue
5145	Pholus	Konrad Guhl	JOA 2 2016
8405	Asbolus	Oliver Klös	JOA 3 2016
10199	Chariklo	Mike Kretlow	JOA 1 2017
20000	Varuna	André Knöfel	JOA 2 2017
28728	Ixion	Nikolai Wünsche	JOA 2 2018
54598	Bienor	Konrad Guhl	JOA 3 2018
60558	Echeclus	Oliver Klös	JOA 4 2017
90482	Orcus	Konrad Guhl	JOA 3 2017
120347	Salacia	Andrea Guhl	JOA 4 2016
136199	Eris	André Knöfel	JOA 1 2018
136472	Makemake	Christoph Bittner	JOA 4 2018

In this Issue:

(944) Hidalgo
The *Mexican* Centaur

Oliver Klös, IOTA/ES, Eppstein-Bremthal, Germany,
oliverkloes@nexgo.de

ABSTRACT: The class of Centaurs was introduced to the world of minor planets in 1977, but the first object of this class was discovered much earlier in Hamburg, Germany. The first Centaur (944) Hidalgo, is now close to its perihelion. Several occultations by this minor planet in the next few years could reveal more about its physical characteristics.

The Discovery

Walter Baade (1893-1960), an astronomer at the Bergedorf Observatory in Hamburg, discovered the object on 1920 October 31 (Figure 1). The new minor planet got the provisional designation 1920 HZ. After calculating the orbit it was obvious that the new object was not a minor planet like any other. Its orbit extends from the inner edge of the asteroid belt at perihelion to an aphelion beyond the orbit of Saturn. An unusually high inclination indicated that it could be an inactive comet. However, the assumed diameter of 40-60 km was quite large for a cometary nucleus.

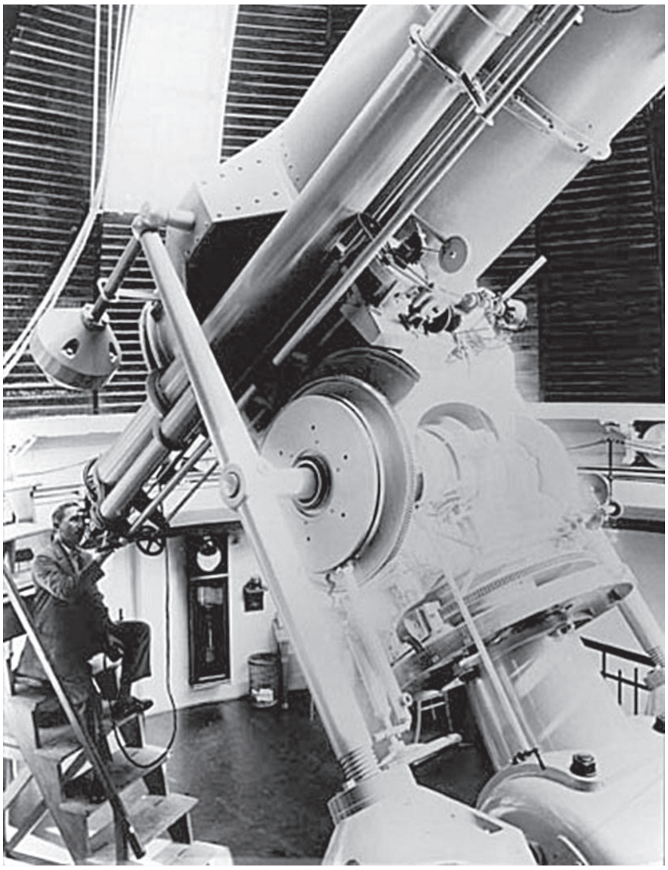


Figure 1 Walter Baade at the guiding refractor of the 1-metre Newtonian telescope of the Bergedorf Observatory in Hamburg, Germany. (Sternwarte Hamburg)

The Name

In 1923 German astronomers travelled to Mexico to observe a total eclipse of the Sun on September 10. The scientists successfully observed the eclipse. This was reported to Germany via telegram [1]. Later, the group had an audience with the Mexican President Álvaro Obrégon. As a thank-you gesture for the support of the expedition by the Mexicans, they asked for his permission to name minor planet 1920 HZ after Mexico's national hero Father Miguel Hidalgo. On 1810 September 16 Father Hidalgo rang the bell of his church to start a popular uprising against the Spanish colonial authorities. Although the uprising failed and Father Hidalgo was executed, the movement for independence for Mexico could not be stopped. The day of the uprising is still celebrated as Mexico's Independence Day.

Most Distant Minor Planet and First Centaur

For 57 years, (944) Hidalgo was the asteroid with the most distant aphelion. In October 1977 Charles T. Kowal found a new object, well known today under the name (2060) Chiron. A distinct minor planet class was introduced – the Centaurs. Their orbits are located between Jupiter and Neptune. (944) Hidalgo approaches the centre of the Solar System beyond the orbit of Jupiter at perihelion, so it is listed as a Centaur and at the Minor Planet Center as a Main-Belt Object [2]. Newly discovered objects in this class were named after Centaurs from Greek mythology, but the first member of this class ever found bears the name of a Mexican revolutionary hero.

The Orbit

(944) Hidalgo orbits the Sun in 13.8 years. It approaches the Sun up to 1.95 AU at perihelion and reaches the inner edge of the asteroid belt. Its aphelion is located beyond the orbit of Saturn at a distance of 9.54 AU from the Sun. The orbit has a high inclination of 42.5° and an eccentricity of 0.67 (Figure 2). Because (944) Hidalgo gets as close as 0.33 AU to the orbit of the planet Jupiter, it could be assumed that the high inclination was caused by a close encounter with Jupiter and its orbit is subject to constant changes.

In 1673, (944) Hidalgo and Jupiter were only 0.44 AU apart. It was the closest encounter in a period of 400 years (Table 1) [3]. The last close encounter took place on 1922 October 21. (944) Hidalgo passed Jupiter at a distance of only 0.89 AU.

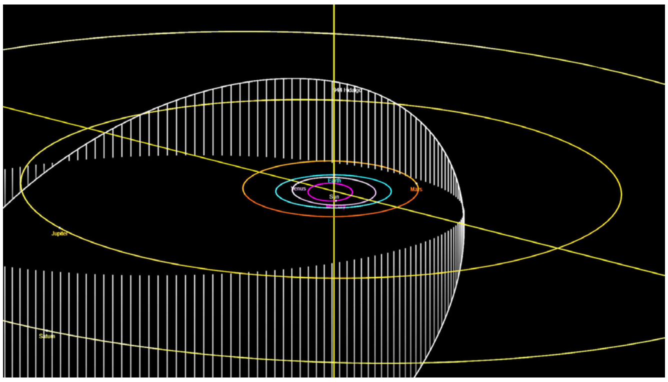


Figure 2 (944) Hidalgo's orbit close to perihelion high above the ecliptic. The Centaur crossed the orbit of Mars inward in November 2018 and will pass it outward again in February 2019. The diagram shows the position of the minor planet on 2019 Feb 1, 00:00 U.T. Orbit diagram: JPL Small-Body Database, 2018

Encounters of (944) Hidalgo with Jupiter1660-2060	
Year	AU
1673	0.38
1756	1.51
1827	0.84
1922	0.90

Table 1

Physical Characteristics

The true diameter of (944) Hidalgo is still uncertain. Different sources report values from 38 km to 61 km with a rotation period of 10 h. The reason for this could be the elongated shape of the asteroid determined by photometric measurements (Figure 3) [4]. The minor planet is a dark body with an albedo of 0.06. Occultation observations could help to provide more accurate data about the size and shape of this unusual object.

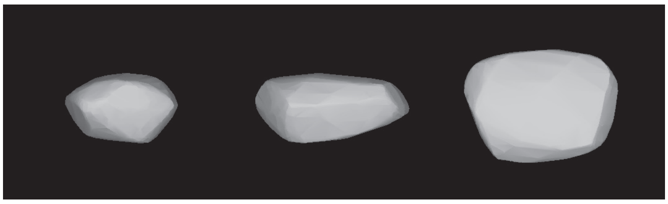


Figure 3 These 3-D models indicate an elongated, flat shape of (944) Hidalgo. Models: Ďurech et al. DAMIT-Database of Asteroid Models from Inversion Techniques, 2018

At Perihelion in 2018

The minor planet has passed its perihelion on 2018 October 27 and is now high above the horizon for northern hemisphere observers. Its closest approach to Earth was on 2018 November 24 with a distance of only 1.45 AU and an apparent magnitude of 14.3. In June 2020 the Centaur will cross the ecliptic to the southern hemisphere and will move on into the outer Solar System (Figure 2). (944) Hidalgo will reach aphelion on 2025 September 12. Its brightness will drop to fainter than magnitude 21 [5].

Occultations – Past and Future

There were several predictions in the past for occultations by (944) Hidalgo, but only one of these events has been observed with success (Dec 2018). Peter Delinčák, Slovakia, observed an occultation of UCAC4 835-011935 by the Centaur on 2018 December 6. He reported a very short occultation of 0.79 ± 0.05 seconds only. [6]

Upcoming occultations for the years 2019-2024 are listed in Table 2. Steve Preston, IOTA, has already calculated predictions for events in 2019. Some good opportunities to observe an occultation by the Centaur are predicted for 2019. Maps for four events are presented here. Unusually for observers in the northern hemisphere, these events will be located above the northern horizon.

On February 16 there will be the best opportunity in the next few years to observe an occultation by this Centaur. The expected duration of the occultation of a 10th magnitude star is 3.3 seconds. The path will cross Wyoming, Montana and Washington in the U.S.A. and Vancouver in Canada. The target star will be about 50 degrees above the northern horizon (Figure 4) [7].

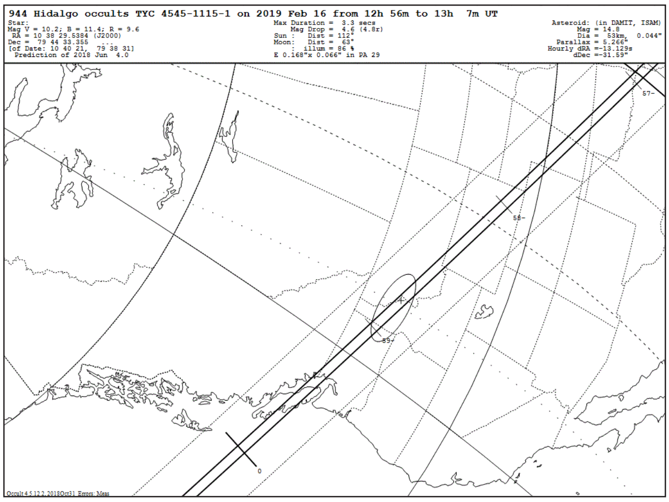


Figure 4 The predicted path for the occultation on 2019 February 16 before sunrise. Prediction by S. Preston, IOTA, 2018 Jun 4.

Upcoming Occultations by (944) Hidalgo in 2019 - 2024, Target Stars < 13 Vmag				
Date	Star	VMag	Dur	Where
2019 Jan 22	UCAC4 855-8979	13.0	6.6	North Africa
2019 Feb 16	TYC 4545-01115-1	10.2	3.3	Northwest U.S.A., Western Canada
2019 Feb 28	UCAC4 834-10692	12.4	2.2	Eastern U.S.A., Canada
2019 Mar 08	UCAC4 818-16917	12.7	2.0	Eastern Iceland, Canaries, West Africa
2019 Mar 31	UCAC4 773-33667	12.3	1.6	Northwest Africa
2019 Apr 02	UCAC4 768-40795	12.8	1.6	East & South U.S.A., Mexico
2020 Mar 24	UCAC4 435-57864	12.7	1.9	Argentina, Chile
2023 Apr 06	UCAC4 224-86357	13.0	2.0	Southern Argentina, Chile
2023 Aug 15	UCAC4 241-70041	11.3	3.5	Peru
2024 Apr 23	UCAC4 189-10892	12.4	1.8	North Africa
2024 May 30	TYC 8305-01011-1	11.7	1.8	South Argentina, Chile, SW Australia
2024 Jun 02	UCAC4 191-101634	12.6	1.8	Chile, Bolivia, Brasil
2024 Jun 18	TYC 8292-00922-1	11.6	2.0	Malaysia, Indonesia
Events in 2019 predicted by S. Preston, IOTA Events 2020 - 2024 predicted by O. Klös, IOTA/ES with Occult V4, Astorb 2018 Oct 27, Gaia14DR2				

Table 2

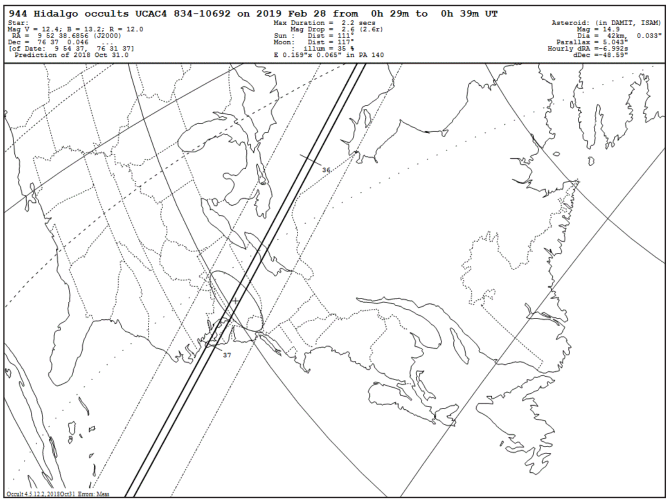


Figure 5 Another opportunity for observers in North America will be on 2019 February 28. Prediction by S. Preston, IOTA, 2018 Oct 31.

Another event for observers in the U.S.A. will occur on February 28. This occultation of a 12.4 mag star will cross Canada and the states New York, Pennsylvania and Delaware in the U.S.A. The target area is about 48 degrees above the northern horizon (Figure 5) [8].

On March 8 the shadow of (944) Hidalgo will miss Europe, only eastern Iceland will be inside the path. But more on its way to the south, the area

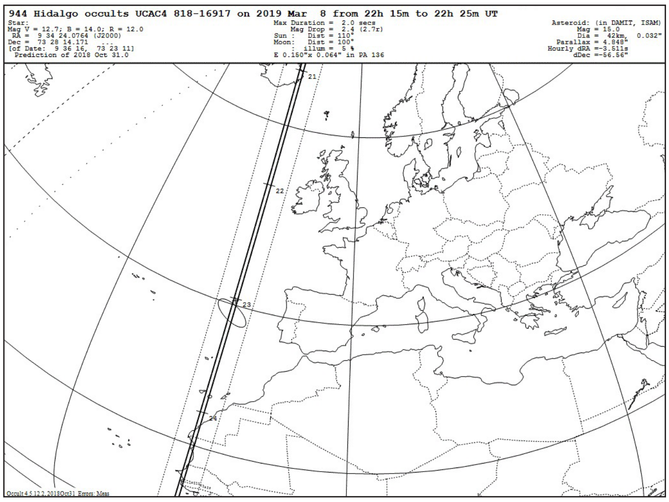


Figure 6 (944) Hidalgo's shadow will miss Europe on 2019 March 8, but the Canary Islands will be inside the path and its error limits. Prediction by S. Preston, IOTA, 2018 Oct 31.

of the Canary Islands will be inside the path and its 1-sigma limits. The expected duration for this event with a 12.7 mag star will not exceed 2.0 seconds. The occultation is again visible above the northern horizon, at 43 degrees altitude (Figure 6) [9].

On April 2 the shadow path of (944) Hidalgo will come from Eastern Canada, cross the U.S.A. on a line from Indiana to Texas and move on to the northern part of Mexico. The target star (mag 12.6) will be about 40 degrees above the northwestern horizon. This time the duration will not exceed 1.6 seconds (Figure 7) [10].

Conclusion

(944) Hidalgo is a very interesting minor planet which represents the double-faced mythological Centaurs very well. Half Centaur, half Main-

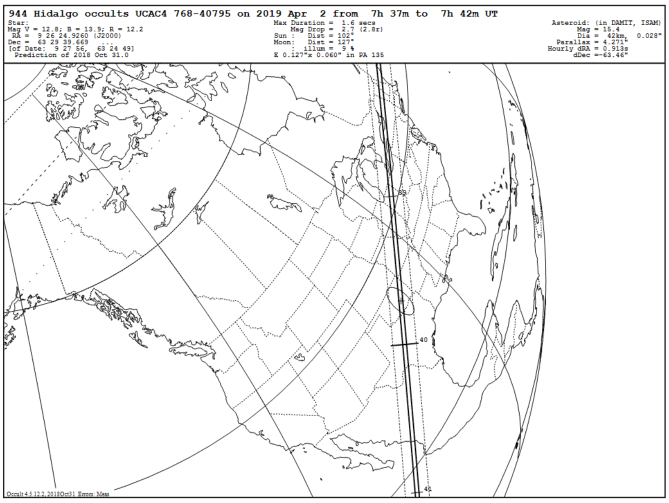


Figure 7 On 2019 Apr 2 the predicted path will cover a large area in the U.S.A. Prediction by S. Preston, IOTA, 2018 Oct 31.

belt-object and half comet, half minor planet. Measurements of occultations by (944) Hidalgo in the next few years could reveal more details about this strange Mexican Centaur while it moves on to the outer regions of the Solar System.

Acknowledgement

The author wishes to thank Steve Preston, IOTA, for calculating new prediction updates of occultations in 2019 for this paper.

References

[1] Totale Sonnenfinsternis 1923 Sept. 10, Astronomische Nachrichten, volume 219, p.331 http://adsabs.harvard.edu/full/1923AN....219R.331.

[2] IAU Minor Planet Center Database Search, 2018 http://www.minorplanetcenter.net/db_search/show_object?object_id=944

[3] G. A. Chebotarev et al. Investigation of the Orbital Stability of Minor Planets with Cometary Eccentricities. The Motion, Evolution of Orbits, and Origin of Comets, IAU Symposium No. 45, 1972

[4] Ďurech et al. DAMIT - Database of Asteroid Models from Inversion Techniques, 2018 http://astro.troja.mff.cuni.cz/projects/damit

[5] Kéhar, O. Astronomické katalogy, Online Application Using Data from Catalogues, 2018 http://astronomia.zcu.cz/katalogy/minorplanet-944

[6] Delinčák, P. Observation report via e-mail to PLANOCCULT, 2018 Dec 8

[7] Preston, S. Prediction of Occultation by (944) Hidalgo, 2019 Feb 16 http://asteroidoccultation.com/2019_02/0216_944_62732.htm

[8] Preston, S. Prediction of Occultation by (944) Hidalgo, 2019 Feb 28 http://asteroidoccultation.com/2019_02/0228_944_63396.htm

[9] Preston, S. Prediction of Occultation by (944) Hidalgo, 2019 Mar 8 http://asteroidoccultation.com/2019_03/0308_944_63398.htm

[10] Preston, S. Prediction of Occultation by (944) Hidalgo, 2019 Apr 2 http://asteroidoccultation.com/2019_04/0402_944_63404.htm

Further Reading

Orbital elements at the JPL Small-Body Database
https://ssd.jpl.nasa.gov/sbdb.cgi?sstr=944

Detailed report about the German expedition to the Solar eclipse in 1923 (in German): Schramm, J. Sterne über Hamburg – Die Geschichte der Astronomie in Hamburg, Kultur- und Geschichtskontor, Bergedorf, 2010
http://www.friedensblitz.de/sterne/sonne/1923.html

Ďurech et al. (2010), DAMIT: a database of asteroid models, A&A, 513, A46, ADS: 2010A&A...513A..46D,

ESOP XXXVII

Report of the 37th European Symposium on Occultation Projects

Rokycany/Plzeň, Czech Republic, 2018 August 24-26 (27-28) · www.esop37.cz/

Alex Pratt · IOTA/ES, BAA · alex.pratt@bcs.org.uk

Fig. 1. The participants of ESOP in Rokycany. (C. Eberle)

ABSTRACT: A total of 46 amateur and professional occultation observers and researchers from Algeria, Austria, the Czech Republic, Germany, the Netherlands, Poland, Slovakia, Spain, Switzerland, Ukraine, the United Kingdom and the United States, with accompanying persons, attended the 37th annual science meeting of IOTA/ES in the town of Rokycany, Plzeňregion, Czech Republic, during the weekend of 2018 August 24 to 26, followed by social excursions on the next two days. Video links enabled live online presentations from colleagues in France and Iran.

That weekend there were maintenance works on the railway line between Prague and Plzeň and the disruption and diversions caused some difficulties for none-Czech speaking travellers getting to Rokycany. Thankfully the Local Organising Committee came to our rescue. Informal proceedings began on the Friday evening at the Rokycany and Plzeň observatory on the northern outskirts of the town with delegate registration and a barbecue, snacks and drinks.

Fig. 2. Wojciech Burzyňski and Karel Haliřřinside the dome of Rokycany Observatory. (O. Klös)

Fig. 3. Dusk at Rokycany Observatory. (O. Klös)

Very comfortable accommodation was arranged in Rokycany. The symposium presentations took place during the Saturday and Sunday in the Triana conference room in the Town Hall in the town centre. Accompanying persons visited Plzeň zoo and took a walking tour around Rokycany.

Fig. 4 - Konrad Guhl, President of IOTA/ES, formally opens ESOP XXXVII in the Triana conference room. (K. Halíř)

On the Saturday morning ESOP XXXVII was formally opened by IOTA/ES President Konrad Guhl. He mentioned that ESOP III, the first symposium held outside Germany, took place in the Czech Republic. He introduced Karel Halíř, the Director of the Rokycany and Plzeň observatory, who welcomed everyone to the symposium which presented an interesting and varied series of talks. Most of them, in PDF form and with some links to websites for additional information, can be viewed here:
http://www.esop37.cz/index.php?pr

The abstracts are summarised below:

Saturday 25th August 2018

Lecture Session 1 – Video Cameras (Chaired by Jan Mánek, Czech Republic)

Astro Analogue Video (AAV), (Hristo Pavlov, Australia and England)

The Astro Analogue Video (AAV) file format was created to accommodate the needs of video observers using integrated analogue video cameras. Hristo's talk examined AAV in detail and discussed how it helps video users, and how the free software for Windows program OccuRec can be used to record optimally in AAV format. He discussed how other programs can write and read AAV files.

Fig. 5. Hristo Pavlov gives a lecture about the Astro Analogue Video (AAV) file format. (O. Klös)

Comparing the performance of five cameras (Carles Schnabel, Spain)

The comparative performance of five cameras used for occultation observations was presented and discussed. Carles evaluated the following models:- Mintron 12V6HC-EX, Watec 120N+, Watec 910HX, PointGrey CM3-U3-13S2M and QHY174M-GPS.

Lecture Session 2 – Observation Results I (Chaired by Konrad Guhl, Germany)

The Triton occultation of 2017 – The Campaign – The lightcurves – First results. (Wolfgang Beisker, Germany)

One of the most spectacular occultations in 2017 was that of a mag 12.4 star by Triton on the night of October 5. Because of the availability of the latest Gaia star coordinates very precise positioning of observers was possible. More than 60 stations throughout Europe and other locations gathered data, including the SOFIA airborne observatory. Many observers close to the central line observed a large central flash up to 5 times the intensity of the star. Wolfgang presented a first overview and said it will take some time to analyse all the data.

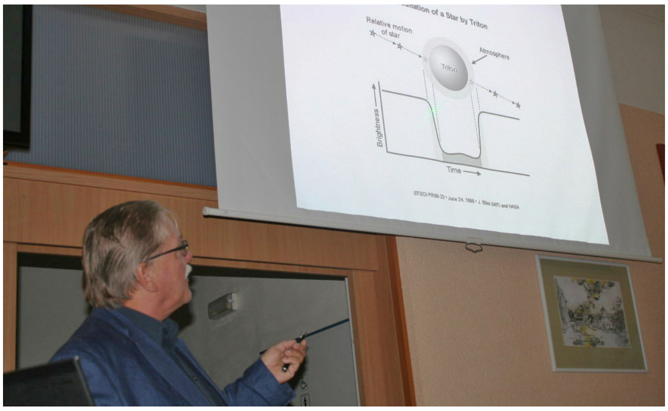


Fig. 6 . Wolfgang Beisker presents a first overview of the Triton Occultation in 2017. (O. Klös)

(386) Siegena and (25) Phocae – 2 observations in 24 hours (Bernd Gährken, Germany)

At ESOP 2016 Eberhard Bredner described his mobile equipment for use at remote sites. This was an inspiration for Bernd to find a comparable solution. He demonstrated his portable observing equipment and the results from his first double positive observation during a holiday in Italy. His next target is a triple success.

Observation campaign of several stellar occultations by asteroids with low probability in Algeria. (Djounaï Baba Aïssa, Algeria)

Djounaï commented that the low probabilities of stellar occultations by Near-Earth Objects or Trans-Neptunian Objects are due to their small apparent sizes. It is interesting to study them by this method to characterise their dimensions and shapes. An observing campaign using the 80cm telescope at Algiers observatory (CRAAG) coupled with a 910HX camera and IOTA VTI was carried out during the first half of 2018. The aim is to record occultations by NEOs with diameters greater than 5 km.

Experiences with high-speed video recording on small telescopes (Jan Mánek)

During the last 4 years Jan has recorded about 60 total lunar occultations with frame rates of 100 fps or higher with two different digital cameras (QHY5L-II-M and ASI174MM) mounted on a 20cm telescope. He presented a short outline of time-linking, the resulting lightcurves and usability.

Lecture Session 3 – Binary Asteroids and Solar Eclipse (Chaired by Jan Mánek)

How to use real data from catalogues of astronomical objects (not only) in education (Ota Kéhar, Czech Republic)

Ota explained that astronomical catalogues have a long tradition; the first reference can be found tens of years BC. Currently they have a fundamental role in space discovery. In the internet age they are available online in updated form, making them easy to browse or search according to various criteria. In their original format they are of limited use in education because pupils are bored with uninteresting tables of data. Their attractive utilisation in schools was described, illustrated by online applications on astronomia.zcu.cz using catalogues of astronomical objects (stars, minor planets, deep-sky objects and exoplanets).

Fig. 7. Ota Kéhar shows his online application for using catalogues of astronomical objects. (O. Klös)

Baily's Beads observations during the total solar eclipse on 2017 August 21 (Konrad Guhl)

Measuring the diameter of the Sun has been a fundamental challenge for more than 2,000 years. Francis Baily (1774-1844) described the tiny points of sunlight shining in the lunar valleys during a solar eclipse. IOTA and IOTA-ES have been observing these Baily's Beads at many eclipses, with the aim to measure the solar diameter and to detect any variations. Konrad presented the results from the 2017 IOTA-ES expedition to the eclipse shadow edges on August 21 and he gave an outlook for the 2019 eclipse.

Fig. 8. Konrad Guhl gives a report about Baily's Beads observations during the solar eclipse in August 2017. (O. Klös)

IOTA/ES General Assembly

The business meeting of IOTA-ES took place at the end of the day's series of talks.

Symposium Dinner

The social highlight of ESOP, the Symposium dinner, was held in the Hotel Corso.

Sunday 26th August 2018

Lecture Session 5 – Observation Results II (Chaired by Eberhard Riedel, Germany)

Results from participating in PHEMU15 (Alex Pratt, England)

Alex took part in the PHEMU15 campaign to obtain photometric observations of the mutual phenomena of Jupiter's Galilean satellites during 2014-2015. He submitted data on 18 events and 17 were used in the PHEMU15 report. He discussed the results from the PHEMU15 catalogue and the IAU Natural Satellites Database, and summarised the observing prospects for PHEMU21.

300 occultations during two years at new K71 observatory – experiences and results (Björn Kattentidt, Germany)

Björn explained his selection criteria when planning to observing occultations, based on data given by OccultWatcher. He presented a detailed analysis of his statistics. Short videos of 9 positive occultations showed different types of occultations.

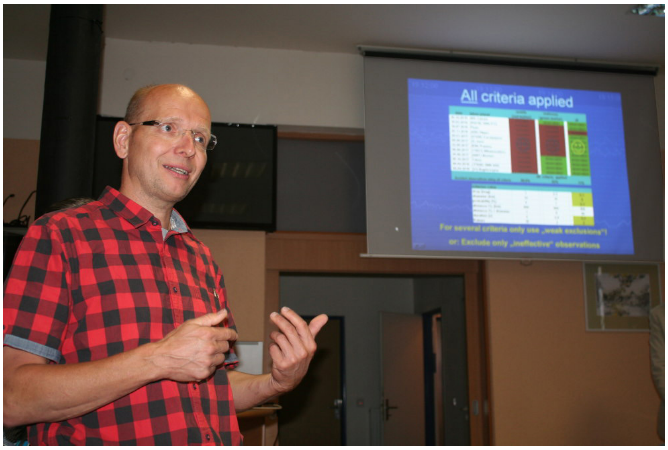


Fig. 9 . Björn Kattentidt reports about his experiences during the last two years. (O. Klös)

Observation of total lunar occultations during lunar eclipses in 1986, 2015 and 2018 (Konrad Guhl)

During a total lunar eclipse the brightness of the Full Moon is reduced and it is possible to observe total lunar occultations. Konrad's first visual observations were during the eclipse of October 17, 1986. For the eclipse of September 2015 he used a Watec camera on a 180/1800mm telescope. These observations were reported to IOTA. He presented the challenges and results of the 2018 eclipse.

Observation of occultations in Czechia and observing sets (Jiří Kubánek, Czech Republic)

There is a long tradition of occultation observing in the Czech Republic. Jiri said visual observations of total lunar occultations were substituted by observations of occultations by minor planets using objective methods. The purchase of observing sets (telescopes, cameras, VTIs and notebook computers) for observations has increased the number of events being monitored and successfully recorded.

Fig. 10. Jiří Kubánek gives an overview of the observations in the Czech Republic. (K. Halíř)

Two eclipses in two weeks (Roman Kostenko, Ukraine)
Roman described his experiences of observing the lunar eclipse of July 27, 2018 and the partial solar eclipse of August 11.

Lecture Session 6 – Software (Chaired by Oliver Klös, Germany)

Computer time setting via NTP with Meinberg software (Nikolai Wünsche, Germany)
Occultation observers using digital cameras with a USB- or a FireWire-port need an accurate computer clock. Niko discussed the Network Time Protocol and explained how Meinberg's NTP client software can synchronise a computer to within a few milliseconds of UTC. The Meinberg Time Monitor provides detailed information about the reliability of the synchronisation and the computer clock offset.

GRAZPREP – Still new features (Eberhard Riedel)
Since 2011 "GRAZPREP" software is used by increasing numbers of grazing occultation observers to identify all upcoming events in their region and examine the necessary details to plan for successful observations. GRAZPREP can be used on a mobile Windows PC or tablet to visualize the occultation circumstances from any location. Eberhard explained some of the new features and mentioned a planetarium tool add-on being developed for stellar occultations by the Moon or the major planets.

Guide add-in for OccultWatcher (Andreas Eberle, Germany)
For many years now, OccultWatcher is the essential software for planning observations and coordinating observers along the shadow path. Its flexible software structure allows add-ins with additional functionality. Andreas has written an add-in that allows the user to invoke "Guide" planetarium software directly from within OccultWatcher.
Delegates then gathered near the fountain in Masaryk square for the Symposium group photograph (Fig. 1).

Fig. 11. Andreas Eberle demonstrates his GUIDE add-in for OccultWatcher. (O. Klös)

Lecture Session 7 – Observation Results III (Chaired by Carles Schnabel, Spain)

Highlights of occultation observations in Poland 2018 (Wojciech Burzyński, Poland)
Wojciech presented the results of observations of the most spectacular occultation events recorded this year in Poland, including numerous faint lunar occultations, grazing lunar occultations and the detection of a new double star from an asteroidal occultation.

Introducing RO3 Project
(Atila Poro, Iran – presented by Javad, via Skype)
This is one of IOTA/ME's projects on observing occultations that was introduced for the first time in this workshop.

UK observations in 2018: successes, new CCD users, and a lunar graze (Tim Haymes, England)
Tim summarised observations made by UK observers in the last year including some contributions made by new observers with digital USB cameras. His presentation was illustrated with examples of asteroidal and lunar occultations, and an historical investigation into a previously unreported lunar graze.

Fig. 12. Tim Haymes presents observations made by UK observers in 2017. (O. Klös)

The Triton stellar occultation of October 5, 2017 in the Gaia era (Prof Bruno Sicardy, France – via Skype)
On 5th October 2017, Neptune's largest satellite Triton occulted a magnitude 12 star; the last favourable one occurred in 1997. It is the only satellite, apart from Titan, to possess a bound atmosphere and it is very similar to Pluto's. Triton's atmosphere is controlled by its surface, with

gaseous and solid phases of N2 being at vapour pressure equilibrium. Drastic seasonal effects are present on the satellite.
The October 2017 occultation was observed from several stations. The Gaia catalog DR1, plus a partial pre-release of DR2, greatly improved the predictions. More than 80 stations (mainly amateurs) recorded the event, mostly in western Europe, with some in northern Africa and eastern USA. Bruno presented preliminary results, discussing changes in temperature and pressure in Triton's atmosphere. The spectacular central flash (recorded by 25 stations) gave insights into the shape of the atmosphere and the possibility of hazes.

Fig. 13. Nikolai Wünsche (left) and Chad Ellington in the conference room. (O. Klös)

Lecture Session 8 – Occultation Future (Chaired by Jan Mánek)

Occultations by Asteroids – Highlights for Europe in 2019 (Oliver Klös)
In June 2018 Steve Preston (IOTA) provided the first predictions for 2019. Oliver's presentation, with path maps, showed some of the highlights which will cross Europe.
Occultations of bright stars: Large uncertainties in some paths of bright events require a wide distribution of stations. Good opportunities to promote occultation observations in the astronomy community.
Occultations by minor planets with satellites: High frame rate video cameras can detect these small companions and improve their orbits. Occultations by (87) Sylvia and the moons Romulus and Remus are highlighted in 2019.

IOTA/ES basic observations with a small telescope (Eberhard Bredner, Germany)
When preparing for an excursion to observe an occultation we try to take with us the largest equipment possible. But when you are on holiday the possibilities are limited. If an observation occurs during holiday time one has to decide what equipment will be "enough". During three weeks in France Eberhard had the chance to observe some events, total occultations, a grazing occultation and an occultation by the minor planet (2326) Tololo. He gave a report of his personal holiday practical advice.

First solar eclipse canons and Franz Ignatz Cassian Hallaschka (Jan Mánek)
While "Canon der Finsternisse" by Theodor von Oppolzer (1841-1886) from 1887 is well known worldwide, his work was preceded by two smaller canons computed by F. I. C. Hallaschka (1780-1847) and printed in 1816 and 1820. Although they cannot be compared with Oppolzer's work by number of included eclipses, they surely were highly appreciated in their time and were one of the first of their kind. Jan presented an account of Hallashka and his two canons.

Invitation to ESOP 38 in Paris, France (Prof Bruno Sicardy, France – via Skype)

Bruno announced that ESOP 38 will be held in Paris from August 29 to September 3 (dates to be confirmed), with the Friday evening welcome buffet taking place in the historical Cassini Room, Observatoire de Paris.

Closing remarks
At the formal closing of proceedings the delegates expressed their grateful thanks to the Local Organising Committee of Karel Halíř, Alena Halířová, Ota Kéhar, Vladimíra Lukešová and Jan Mánek for a very productive and most enjoyable ESOP.

*Fig. 14. The Local Organising Committee at work.
Jan Mánek, Karel Halíř and Ota Kéhar (from left). (O. Klös)*

Excursion Programme

Monday 27th August 2018
Delegates and accompanying persons took an excursion by coach to the picturesque little town of Bečov nad Teplou. We then had a guided tour of its historical gothic castle. A short drive led us to the spa town of Karlovy Vary (Carlsbad), which is famous for its hot mineral springs. After lunch Mrs Alena Halířová presented each of us with a decorative Karlovy Vary porcelain drinking cup with a curved spout and we proceeded with them along the colonnades, sampling the waters from the various fountains with temperatures between 30 °C and 73 °C.

Fig. 16. Participants of ESOP sample mineral water from the hot springs at the colonnades. (K. Halíř)

Fig. 15. Karlovy Vary porcelain drinking cup. (A. Pratt)

We then took the funicular railway to the Diana lookout and climbed 35 m up the Diana tower to enjoy the panoramic views from 547 m.

Tuesday 28th August 2018

On the final day our journey took us to Kozel castle, where we walked through its extensive gardens before joining a guided tour through its rectangular courtyard and ornate central building. We continued to the city of Plzeň for a detailed tour of the famous Pilsner Urquell brewery, including beer tasting and we were informed that Pilsner is a health drink. After lunch we had a walking tour of Plzeň and some of us climbed up the 100 m tower of St. Bartholomew's cathedral for views over the city.

Another Excellent ESOP!

On our return to Rokycany we said our goodbyes and once again thanked the Local Organising Committee for their hard work, and we all looked forward to meeting in Paris, France in 2019.

Fig. 19. The Town Hall at night, the location of the conference room. (O. Klös)

Fig.17. Tour of the Pilsner Urquell brewery. (K.Halíř)

Fig. 18. A special ESOP wine was presented to lecturers and the LOC. (O. Klös)

Journal for
Occultation
Astronomy

IOTA's Mission

The International Occultation Timing Association, Inc was established to encourage and facilitate the observation of occultations and eclipses It provides predictions for grazing occultations of stars by the Moon and predictions for occultations of stars by asteroids and planets, information on observing equipment and techniques, and reports to the members of observations made.

The Journal for Occultation Astronomy (JOA) is published on behalf of IOTA, IOTA/ES and RASNZ and for the worldwide occultation astronomy community.

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www.occultations.org
www.iota-es.de
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These sites contain information about the organisation known as IOTA and provide information about joining.

The main page of occultations.org provides links to IOTA's major technical sites, as well as to the major IOTA sections, including those in Europe, Middle East, Australia/New Zealand, and South America.

The technical sites hold definitions and information about all issues of occultation methods. It contains also results for all different phenomena. Occultations by the Moon, by planets, asteroids and TNOs are presented. Solar eclipses as a special kind of occultation can be found there as well results of other timely phenomena such as mutual events of satellites and lunar meteor impact flashes.

IOTA and IOTA/ES have an on-line archive of all issues of Occultation Newsletter, IOTA'S predecessor to JOA.

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